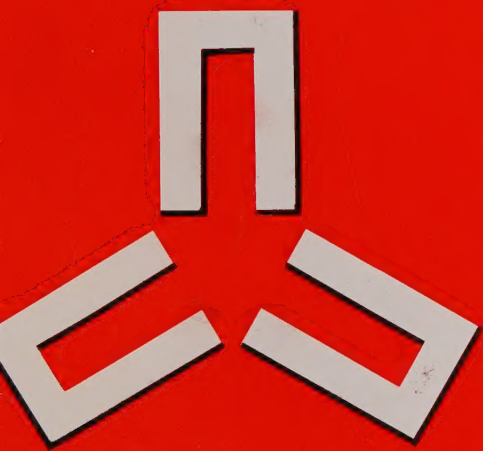




INSTALLATION AND OPERATION MANUAL
ECONO-LINE TOTALIZERS & INDICATORS

SERIES III

 **EG&G**
FLOW TECHNOLOGY



NOTICE

SOME OF THE COMPONENT NAMES AND LOCATION OF THE MODULES MAY VARY FROM THE VALUE AND LOCATION SHOWN ON THE DIAGRAM IN THIS MANUAL. THESE VARIATIONS ARE THE RESULT OF PRODUCTION MODIFICATIONS.

THE DESCRIPTIONS, CONNECTION DIAGRAMS, AND PROCEDURES CONTAINED IN THIS MANUAL ACCURATELY DESCRIBE THE ECONO-LINE UNIT OPERATION AND ADJUSTMENTS.

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ECONO-LINE TOTALIZERS & INDICATORS
SERIES III

EG&G Flow Technology
4250 East Broadway Road
Phoenix, Arizona 85040

December 1983

(662) 437-1315

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SECTION I. INTRODUCTION

1.1 General.

This manual contains complete operating and maintenance instructions for the EG&G Flow Technology, Inc. Econo-Line Totalizers and Indicators. This manual does not include information pertaining to special equipment application, nor does it include instructions for accomplishing repairs of the type performed at the factory.

This manual is divided into 5 sections. Section I provides general information. Section II contains installation instructions. Section III contains information on operation and calibration. Section IV describes the theory of operation. Section V contains maintenance and troubleshooting information.

1.2 General Description.

The EG&G Flow Technology, Inc. Econo-Line Totalizers and Indicators are specifically designed for displaying the output of turbine flowmeters in industrial applications. All units have a common enclosure that allows convenient rack mounting of multiple units.

Solid state circuitry is mounted on modular plug-in printed circuit boards that are easily accessible and are common throughout the series of six models, keeping the required spares to service a panel of instruments to a minimum.

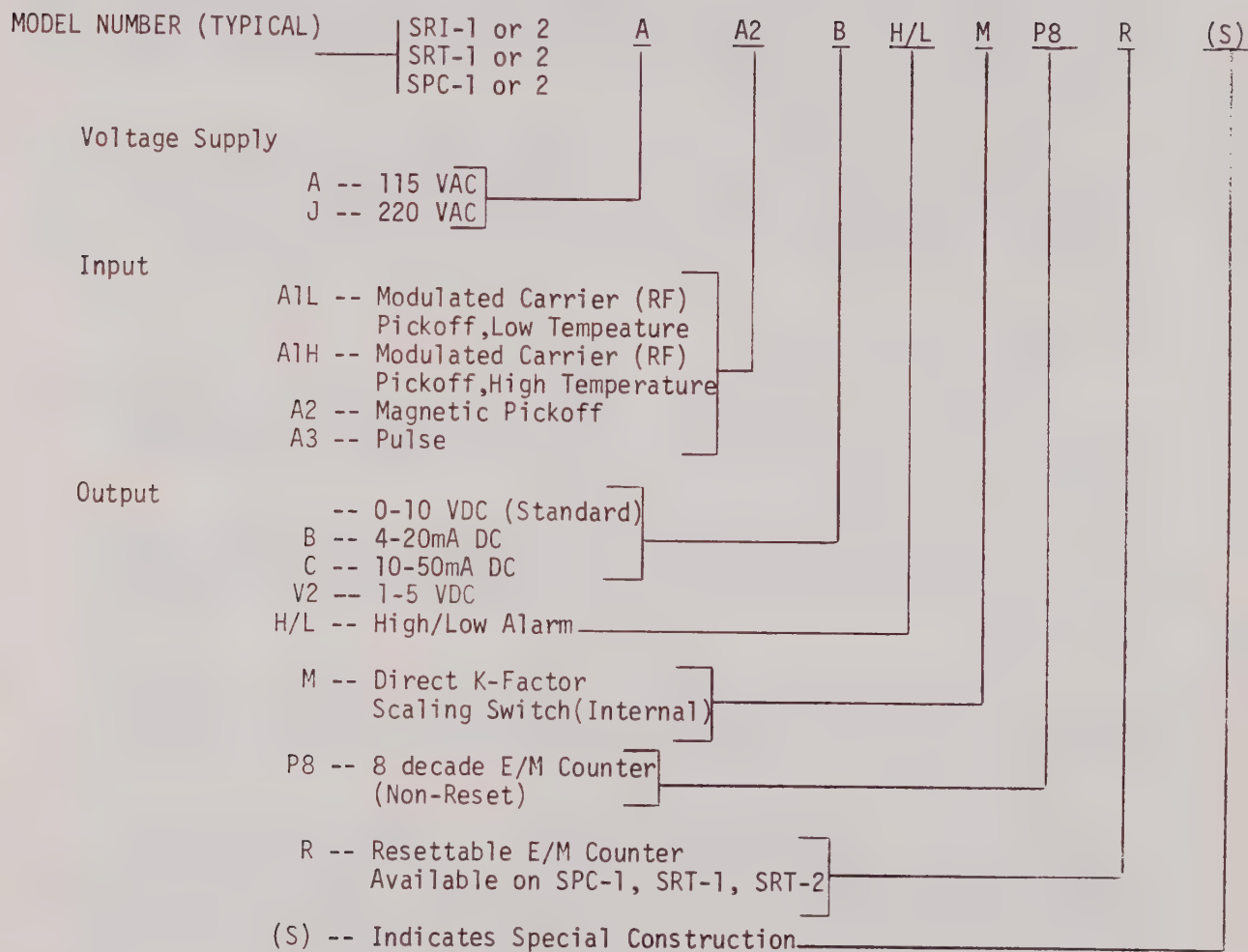
The six different models provide a choice of indicator or totalizer displays (or combinations thereof) in either analog or digital readouts to satisfy nearly every requirement. Specific uses, specifications, and instructions will be discussed for each model.

All models of the Econo-Line Totalizers and Indicators accept input signals from one turbine flowmeter. Visual indication of flow rate and/or total flow is available in either analog or digital representation depending upon the Econo-Line model in use. An analog voltage output is available as well as a pulse output. The pulse output can be internally selected where its frequency is the same as the transducer frequency or scaled into engineering units for external totalizer applications.

Each indicator provides a +24VDC @ 80 mA unregulated output to power an external amplifier or other equipment.

ECONO-LINE

ECONO-LINE SERIES MODEL NUMBERING SYSTEM



1.3 Specifications.

INPUT:

Frequency to range	15 Hz to 12800 Hz
Input level	5 mV to 10v peak-to-peak
Common mode rejection	40 dB minimum: 60 dB typical

OUTPUT:

Analog output voltage	0 to 10 VDC, 5 mA maximum 1 to 5 VDC (optional)
Output Impedance	Less than 5 ohms
Output Current	5 mA maximum with Analog voltage output; Selectable current output of 10 to 50 mA or 4 to 20 mA.
Output Voltage, unregulated	24 VDC @ 80 mA.
Linearity	Better than .1%
Temperature coefficient range (0-50C ⁰)	.04%/C ⁰
Pulse outputs	Selectable 10 volt pulse to correspond to transducer frequency or totalized flow.
Visual outputs	Analog or Digital Flow Rate Indicator and/or 6 digit electro-mechanical counter for totalized flow depending on model.
Allowable Load	600 ohms for 4-20mA 250 ohms for 10-50mA.
Hi/Lo Alarm relay contact rating	28V, 2 amps, AC/DC resistive

CALIBRATION:

Internal calibration

Calibration frequencies of 50, 100, 200, 400, 800, 1600, 3200, and 6400 Hz

Zero adjustment

Front panel

Span adjustment

Front panel

Meter adjustment

Front panel

POWER REQUIREMENTS:

Voltage

115 VAC @ 50-60 Hz nominal.
Internally selectable for 230 VAC @ 50-60 Hz nominal.

Power

Less than 5 watts

SIZE:

3 1/8" wide x 7 1/8" high x 10 1/2" lg.

WEIGHT:

Approximately 4 lbs.

SECTION II. INSTALLATION

2.1 Inspection.

All equipment should be inspected upon receipt for damage to components during shipment. Check all internal plug-in printed circuit boards to be sure they are properly seated in their connectors.

2.2 Installation.

All six models are packaged in a 3" wide x 5-7/8" tall x 10" deep box with a 7-1/8" x 3-1/8" face plate. The standard package comes complete with barrier terminal strips for easy power and signal connections.

Figure 1 shows the mounting configuration for all models. Five units will fit within a standard 19" rack.

Figure 2 gives the dimensions of the recommended panel cut out for installing equipment in an existing panel.

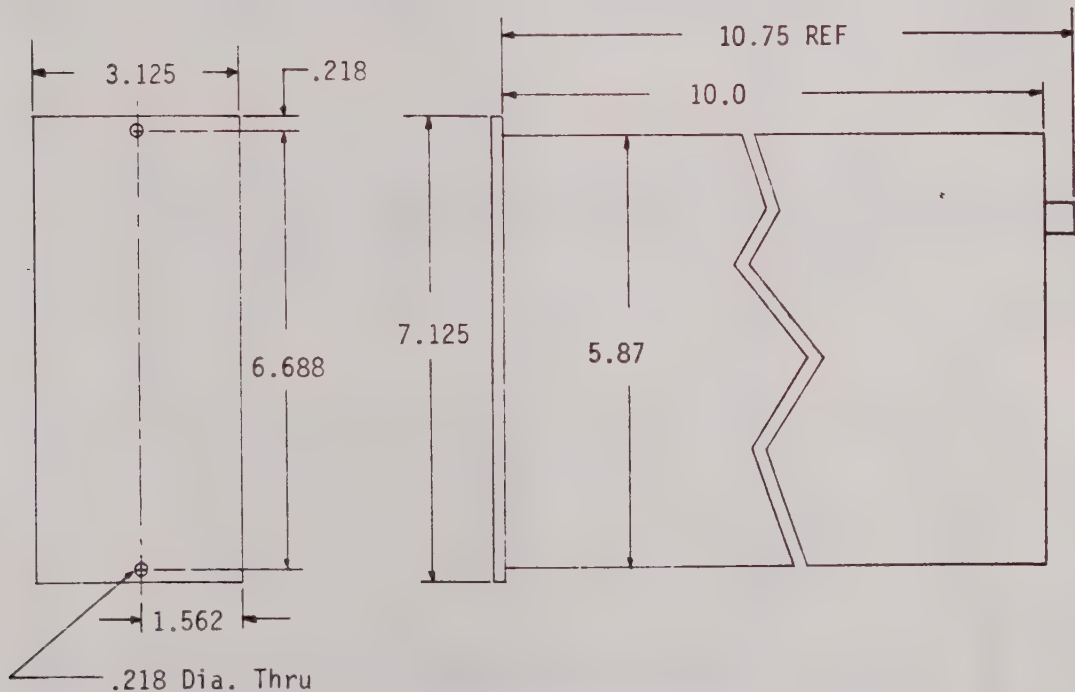


FIGURE 1
INSTALLATION DIAGRAM

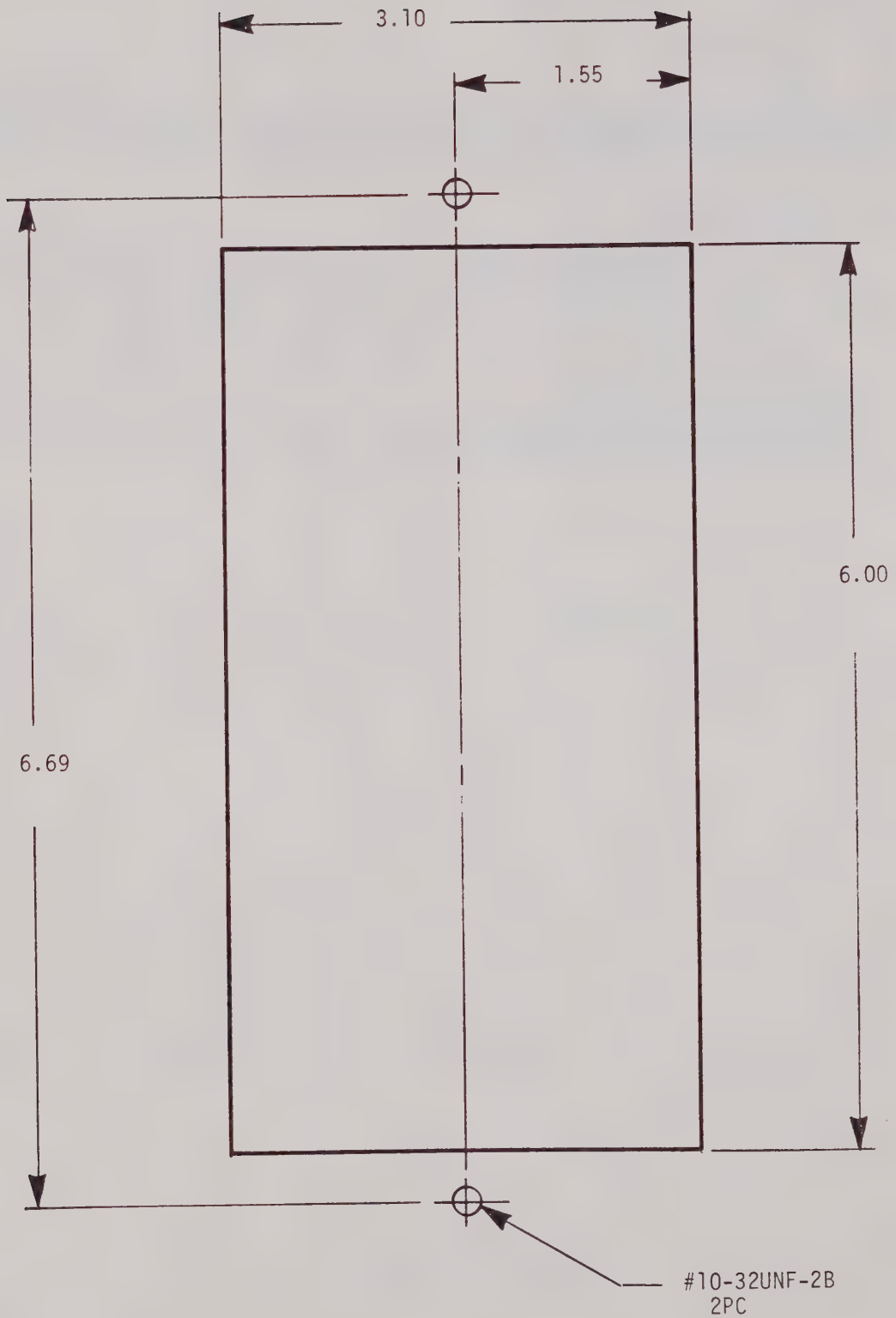
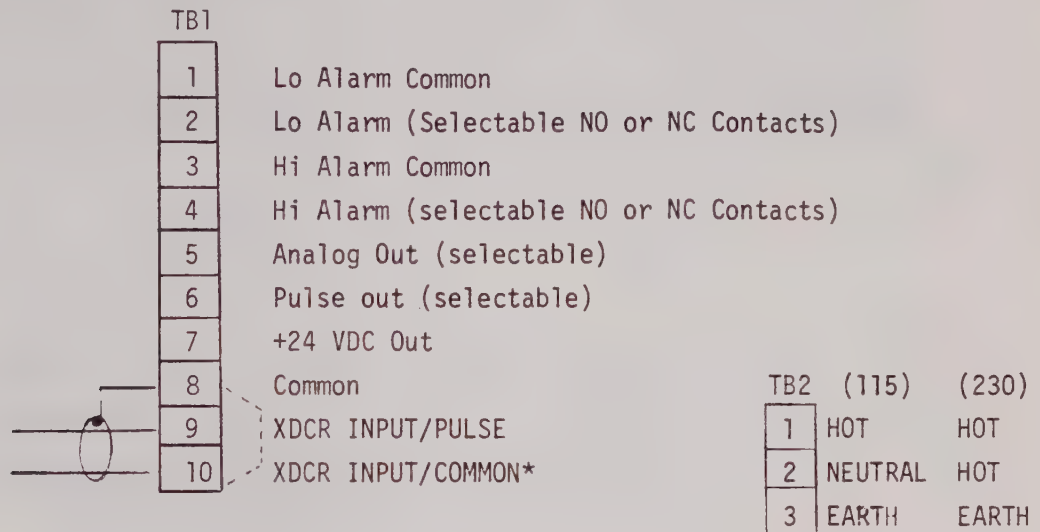


FIGURE 2
DIMENSIONS FOR PANEL CUT-OUT

2.3 Wiring.

Terminal block wiring for connecting both signal and power inputs and signal outputs are shown here in Figure 3.



*Jumper must be installed between TB1-8 and TB1-10 when using a pulse input from a pre-amplifier (LFA or PRA).

FIGURE 3

SECTION III. PRINCIPLES OF OPERATION

3.1 General.

All models of the Econo-Line Totalizers and Indicators accept an input signal from a turbine flowmeter. They furnish either a visual indication of the existing flow rate, a visual indication of the totalized flow, or both depending on the model selected. All units provide analog and pulse outputs at the rear panel connector. An internal oscillator provides a calibration frequency which permits checking the unit at any time with a panel mounted CAL switch. All units also have front panel mounted SPAN and ZERO adjustments. All models are capable of using a modulated carrier amplifier. Visual outputs per model are:

SRI-1.....	Analog Flow Rate
SRI-2.....	Digital Flow Rate
SPC-1.....	Digital Totalized Flow
SPC-2.....	Digital Totalized Flow with Reset and Digital Totalized Flow, Non-Resettable
SRT-1.....	Analog Flow Rate with Digital Totalized Flow
SRT-2.....	Digital Flow Rate with Digital Totalized Flow
SRT-1R.....	SRT-1 with Reset Capability
SRT-2R.....	SRT-2 with Reset Capability

a. SRI-1

The SRI-1 is a simple pulse rate converter which presents a 1 to 100% panel meter indication proportional to flowrate. In addition to the displayed indication, the SRI-1 provides a 0-10 VDC analog voltage output proportional to the flow, and a shaped pulse of the same frequency as the input signal. Current outputs of 10 to 50 mA or 4 to 20 mA, high and low flow limit alarm outputs and scaled pulse out in engineering units are available as options. Refer to paragraph 4.2E, page 23, for an explanation of optional outputs.

b. SRI-2

The SRI-2 is equivalent to the SRI-1 except that it has a digital LED, 3½ digit display rather than a panel meter. The digital display can be set up to read in desired units, such as gallons per minute or liters per hour, for any turbine meter. The SRI-2 also provides analog voltage and shaped pulse outputs, with the current, alarm and scaled pulse out options available.

c. SPC-1

The SPC-1 is a scaling totalizer. The unit counts meter pulses and scales them so the numbers on the electro-mechanical counter represents appropriate quantities (engineering units), such as gallons, liters, barrels, cubic meters, etc. The counter is non-resettable so the accumulated information can never be lost. The CAL switch provides a functional check by causing the unit to count pulses from an internal oscillator. The SPC-1 provides either a 0 to 10 VDC, a 1 to 5 VDC, a 10 to 50 mA or a 4 to 20 mA current output signal proportional to flowrate. The shaped pulse output can be either unscaled (same as input frequency) or scaled (output of totalizer). K-factor divider, high and low flow limit alarms and a resettable totalizer are also available.

d. SPC-2

The SPC-2 is equivalent to the SPC-1 but includes an additional electro-mechanical counter which is resettable. The SPC-2 provides a display of totalized flow and a resettable indication of totalized flow, (i.e. count of total quantity and a count of current batch). The SPC-2 provides the same outputs and options as the SPC-1.

e. SRT-1

The SRT-1 combines the features of the SRI-1 and the SPC-1 into a single instrument. The electro-mechanical counter on the SRT-1 is non-resettable. The SRT-1 provides either a voltage or current output proportional to flowrate. Scaled or unscaled pulse output, K-factor divider, and high and low flow limit alarm are available as options.

f. SRT-2

The SRT-2 is the digital equivalent to the SRT-1. Rate is shown on the LED $3\frac{1}{2}$ digit display and the total quantity is registered on the non-resettable, electro-mechanical counter. The SRT-2 provides a digital indication of flowrate and a digital indication of totalized flow. The SRT-2 provides the same outputs (voltage or current proportional to flowrate), and can provide the same options (scaled or unscaled pulses and high and low flow limits alarm) as the SRT-1.

3.2 F/DC Converter Calibration.

All models contain a frequency to DC converter. This converter requires calibration to the desired full scale flowrate. All models are calibrated at the factory. Additional calibration will not usually be required. The calibration procedures are provided in this manual in case the customer should replace a flowmeter or change operating ranges.

Procedures:

- Step 1. Select a full scale flowrate from the General Transducer Data Sheet that accompanies the flowmeter.
- Step 2. Select a calibration frequency from Table 4 (page 22) Analog Output Scaling. The calibration frequency will be the next lower frequency in the table compared to the full scale flowrate frequency.

Example: If the full scale flow frequency is 700 Hz, at 5 GPM, the calibration frequency will be 400 Hz.

- Step 3. Set the calibration frequency switch on the frequency-to-DC-converter board to provide the selected calibration frequency.
- Step 4. Refer to Table 4, Analog Output Scaling, or Table 5 (page 25) Nomograph and note the values of span-control resistor R20 and frequency-response capacitor C8 that correspond to the selected calibration frequency and desired system response. Install the correct resistor and capacitor in the locations provided for R20 and C8 on the frequency-to-DC converter board.
- Step 5a. Calculate the percentage of meter reading that will represent the calibration frequency as an input with the selected full scale flow rate.

Example:

$$(MR) = \frac{(f_c) (100)}{(f_{FS})} = \frac{400 (100)}{700} = 57.14\%$$

where: MR = Meter Reading in percent

f_c = Calibration frequency

f_{FS} = Full Scale Flowmeter frequency

- 5b. When a digital meter is used to indicate engineering units, calculate the flow rate in engineering units that will represent the calibration frequency as an input with the selected full scale flow rate.

Example:

GPM or PPM or

$$MR_E = \frac{(f_c)}{(f_{FS})} \max \quad MR_E = \frac{(400)}{700} 5 = 2.86 \text{ GPM}$$

For liquid max = Full scale reading from Gallons Per Min

where: MR_E = Meter Reading in engineering units.

f_c = Calibration frequency

f_{FS} = Full Scale Flowmeter frequency

- Step 6. Calculate the Analog output that will represent the calibration frequency for the selected full-scale flow rate.

Example:

$$V_o = \frac{(f_c) (V_F)}{(f_{FS})} = \frac{400 (10)}{700} = 5.714 \text{ volts}$$

where: V_o = Analog Output voltage

V_F = Full scale voltage

f_c = Calibration frequency

f_{FS} = Full Scale flowmeter frequency

Step 7. Adjust the unit as follows:

- a. Connect a voltmeter to the Analog output on the rear terminal (pins 5 & 8).
- b. Turn on power.
- c. Adjust zero potentiometer on the front panel so the voltmeter reads zero volts at the Analog output terminals.
- d. Depress the calibration button and adjust the span potentiometer on the front panel until the voltmeter reads the calculated value (V_o) volts at the Analog output terminals.
- e. Depress the calibration button and adjust the meter calibrate potentiometer, on the front panel, until the front panel meter indicates the value (MR or MR_E) calculated above.

The unit is now calibrated so that a 100% meter reading, (or maximum engineering unit reading) and 10 VDC at the Analog output terminals represents the selected full scale flowrate.

3.3 Totalizer Calibration.

If the model contains a flow totalizer (SPC-1, SPC-2, SRT-1, or SRT-2), the totalizer must be calibrated. This calibration is usually performed at the factory, and the procedures are described here for customer information.

The Flow Totalizer incorporates a scaling system consisting of a multiplier and a divider circuit. This permits a single model to be used with flowmeters having different K-factors and permits the scaling to be set-up in the field if required. The following procedure should be followed to set-up the Totalizer scaling system:

Step 1. Determine the K-factor of the turbine flowmeter from the calibration sheet that accompanies the flowmeter. When the measured flow rate is reasonably steady, use the K-factor for that flow rate as shown on the calibration sheet. When the flow rate varies, use an average K-factor calculated from the calibration sheet.

Step 2. Use the following formula to determine the multiplier.

$$M = \frac{D}{K \times R}$$

Where: M = multiplier
D = divider number (see next paragraph)
K = flowmeter K-factor
R = desired totalizer resolution -- i.e.: 0.01, 0.1, etc.

Step 3. Determine the divider number that will permit the multiplier to be between 0.500 and 0.999. This will be one of the numbers from Table 2.

TABLE 2
Divider Numbers

1			
2	16	128	1024
4	32	256	2048
8	64	512	4096

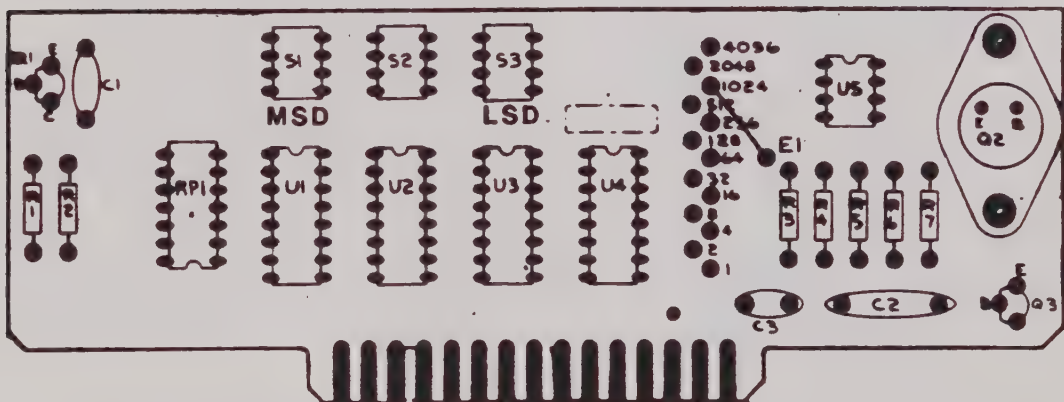
The divider can be determined by using the following formula:

$$D_{\max} = K \times R \times 1$$

$$D_{\min} = K \times R \times .5$$

Select the number from Table 2 that falls between these two values. When this number has been selected, it should be hardwired into the scaler board as shown in Figure 4.

Step 4. The resulting multiplier will be a three-digit number, for example: 0.574. There are three sets of switches on the scaler printed circuit board as shown in Figure 4. One is marked "MSD" for Most Significant Digit, and another is marked "LSD" for Least Significant Digit. The three digits -- 5, 7, and 4 in our example -- must be set into these switch sets. Each set consists of four individual switches wired in binary code. In the example, 5 is the most significant digit, so it is set into the MSD switch set. Number 4 is set into the LSD switch set, and number 7 is set into the remaining switch set. To set a decimal number into these binary switch sets, follow the switch code shown below. X = closed switch. 0 = open switch.



SCALER BOARD ECONO-LINE
Figure 4
Scale Factor

Decimal Number	Individual Switch Number				BCD Value
	1	2	3	4	
0	(1) 0	(2) 0	(4) 0	(8) 0	
1	X	0	0	0	
2	0	X	0	0	
3	X	X	0	0	

4	0	0	X	0
5	X	0	X	0
6	0	X	X	0
7	X	X	X	0
8	0	0	0	X
9	X	0	0	X

BCD = Binary Coded Decimal. i.e. Binary 2 plus Binary 4 equals decimal 6.

Step 5. Check Counter Speed: Solve the following equation to insure that the counter rate will not exceed its limit of 25 counts per second.

$$C = \frac{Fr}{R \times 60}$$

Where: C = counter speed in counts per second
Fr = maximum anticipated flow rate in GPM
R = totalizer resolution -- i.e.: 0.1, 0.01, etc.

Step 6. Calibration check. When the CAL switch is actuated, the internal calibration pulses replace the flowmeter input pulses to the totalizer. Since the frequency of the calibration pulses is set to less than the frequency of the flowmeter pulses, the totalizer count will be proportionally lower for calibration checks. The equivalent flowrate is determined by the ratio of the calibration frequency to the flowmeter full scale frequency. Assume, for example, that a flowmeter has a full scale flowrate of 2 GPM with an input frequency of 1000 Hz. The calibration frequency will be 800 Hz (See F/DC calibration). The equivalent flowrate will be $\frac{800}{1000}$ or .8 of the full scale flowrate. A timed check of 2 minutes should produce a totalizer count of 3.2, provided the resolution of the totalizer is .1. If the resolution of the totalizer is .01, then a 1 minute timed check should produce a totalizer count of 1.60.

Sample Calculation:

Given: K = 28740 pulses per gallon
R = 0.1 gallon totalizer resolution
Fr = 2 gallons per minute (from flowmeter calibration sheet)
f = 1000 Hz (from flowmeter calibration sheet)
f_c = 800 Hz calibration frequency selected

$$D_{\max} = K \times R \times 1 = (28740) (.1) (1) = 2874$$

$$D_{\min} = K \times R \times .5 = (28740) (.1) (.5) = 1437$$

$$M = \frac{D}{K \times R} = \frac{2048}{28740 \times 0.1} = \frac{2048}{2874} = .7126$$

Round that off to a three-digit number, 0.713. The three switch sets are set-up as follows:

Switch number	1	2	3	4
MSD 7	X	X	X	0
1	X	0	0	0
LSD 3	X	X	0	0

Counter speed is determined as follows:

$$C = \frac{FR}{R \times 60} = \frac{2}{0.1 \times 60} = \frac{2}{6} = 0.333 \text{ counts per second}$$

(This is well within the 25 counts per second.)

3.4 Flow Totalizer Calibration w/K-Factor Divider (Option)

Calibrating an Econo-Line unit that is equipped with a K-factor divider (KFD-module) is relatively easy. The operator simply sets the flowmeter K-factor on the appropriate switches by using a small screwdriver to operate switch. The switch positions (MSD & LSD) are shown in drawing 02D82543 and figure 5.

Resolution of the Totalizer can be changed by multiplying the K-factor by .01, .1, 10, etc.

EXAMPLE: K = 34388 pulses per gallon.

A resolution of .01 gallons is desired.

Multiplying 34388 by .01 equals 344. Set 344 on the K-factor divider board switches; S3, S2 and S1, respectively.

If a resolution of 10 gallons is desired, set 343880 on the switches (34388 x 10).

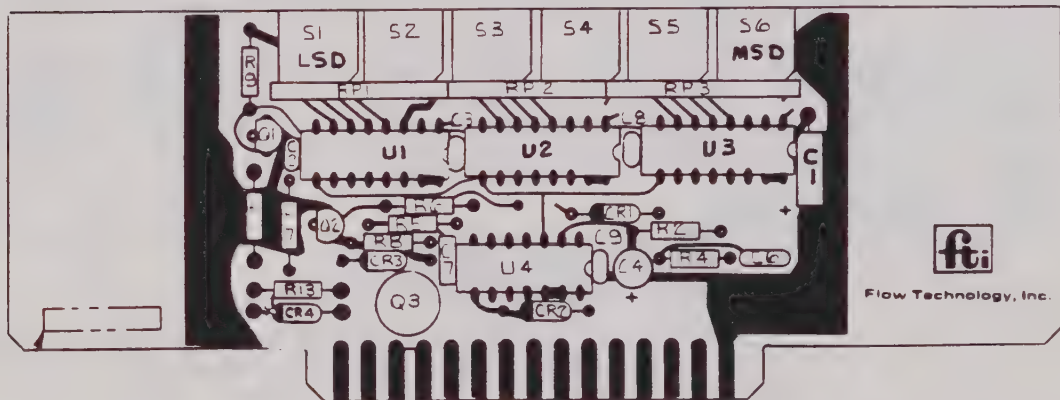
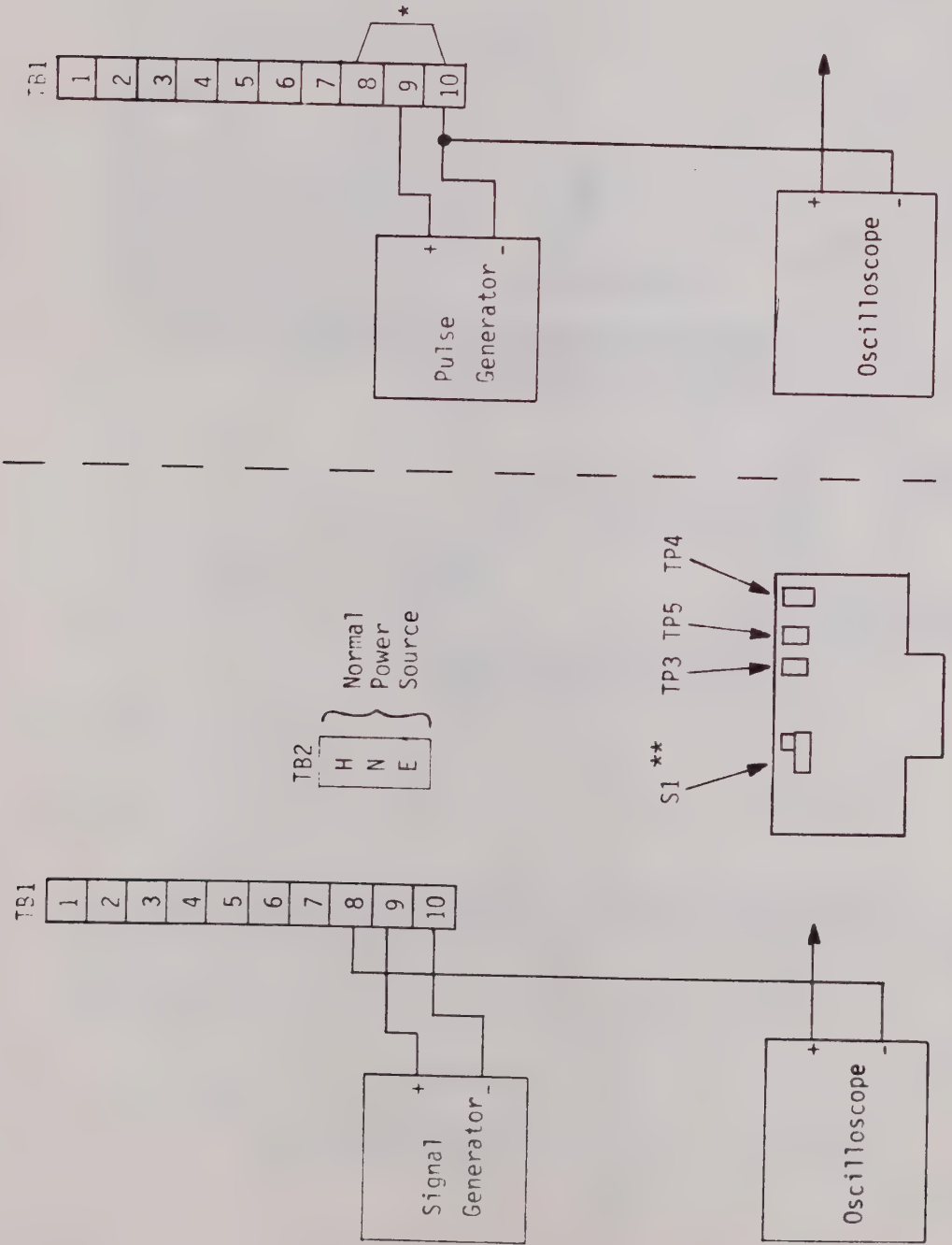


FIGURE 5. K-FACTOR DIVIDER BOARD

NOTE: The KFD module must have an additional resistor (R13) and diode (CR4) installed as shown in schematic drawing 63D82543 when used in the Econo-line models SRI-1 or SRI-2 (without electro-mechanical counters).

NOTE: Use the K-factor from the data sheet that accompanies the transducer. If the data sheet does not provide the K-factor for the exact flowrate that is desired, interpolate the calibration data for the applicable K-factor.



** NOTE: On some models of Preamplifier Modules (02-82540) the selector switch is not installed. The input mode (magnetic transducer or pulse) is determined at the factory and hardwired using jumpers.

Magnetic Transducer

Pulse Input

FIGURE 7 PRE-AMPLIFIER CALIBRATION INTERCONNECT DIAGRAM

3.5 Pre-Amplifier Module Calibration

A pre-amplifier module (magnetic or modulated carrier) is used in all models of the Econo-Line series. The magnetic pre-amplifier is supplied with units configured for magnetic transducer or pulse input; a selector switch on the module is set for the desired mode.** The calibration of these modules is performed at the factory and the procedures are described in the following paragraphs. An oscilloscope is required for these procedures.

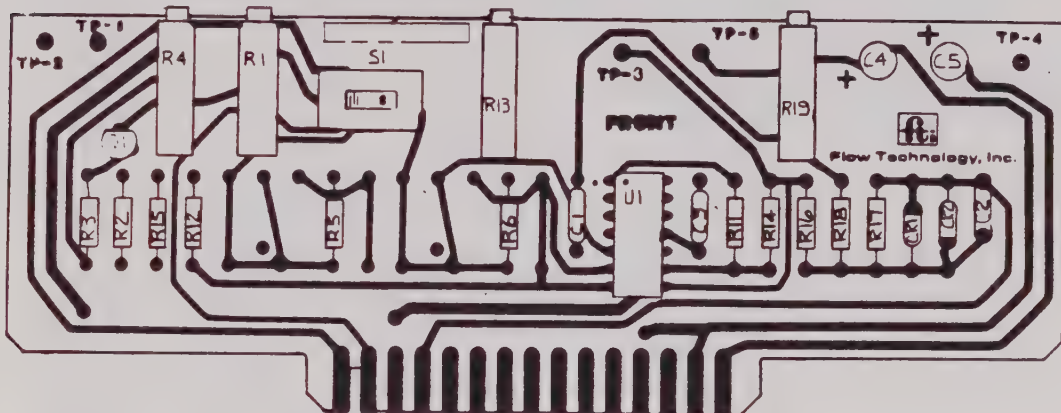


FIGURE 8. PRE-AMPLIFIER MODULE (02-82540)

1. Magnetic Transducer - Input (Figure 8)

1. The pre-amplifier module (02-82540) should be installed and the unit connected to the appropriate power source. The selector switch must be set to the MAG position (toward rear panel). **
2. Connect the oscilloscope to TP3 on the pre-amplifier module. TP5 may be used as the ground connection.
3. Connect the Signal Generator to the Econo-Line unit and set for a sine wave output within the range of the flowmeter at the amplitude of the flowmeter input signals (See data sheet).
4. Apply power to unit and test equipment. Adjust the oscilloscope for a pulse display.

NOTE: The waveform displayed on the oscilloscope can be either clear, sharp steady pulses, or pulses with indefinite (oscillating) leading and trailing edges.

5. If the pulse waveform edges oscillate, adjust R13 for a clear, sharp, steady pulse at TP3.
6. Connect oscilloscope to TP4.
7. Adjust R19 for maximum pulse amplitude, with 50% duty-cycle wave.
8. Repeat steps 5 through 7 until the pulses are clear, sharp and steady at TP3 and have maximum amplitude at TP4.

** See Note on page 14.

2. Pulse - Input

These procedures are performed only when the unit is used with a pulse input.

1. Perform the magnetic pre-amplifier adjustments described in the preceding paragraph, in steps 1 through 8.
2. Set the selector switch to Pulse position (toward front panel). **
3. Connect pulse generator to TB1 as shown in figure 7.
Set the pulse generator for the flowmeter full scale frequency with an amplitude of 10 volts peak-to-peak.
4. Connect oscilloscope to TP2.
5. Adjust R1 and R4 for maximum pulse amplitude, and a clear, sharp, steady pulse at TP2.
6. Check the waveforms at TP3 and TP4. Adjust as necessary.

** See Note ** page 14

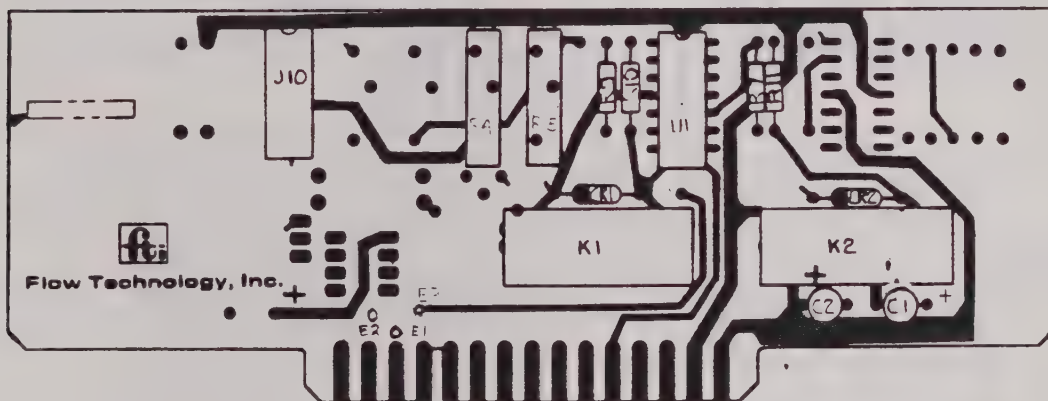


FIGURE 9. HI/LOW ALARM MODULE

3.6 High/Low Alarm Adjustment Procedure.

The High and Low Alarm circuits are set-up using the analog output of the F-DC Converter. The F-DC Converter provides a 0-10 VDC output that is directly proportional to the input frequency of the flowmeter with +10 VDC representing the frequency at the full scale flow rate. The alarms are usually set at 90% and 10% of flow rate at the factory unless the user specifies otherwise.

Relays K1 and K2 are DC relay contacts and the user must supply an external DC/AC voltage (2 amps/28 volts max.) to the relay wiper and select the NC or NO relay output connection. *NOTE: Relays K1 and K2 cannot accept 110 or 220 VAC signals. External relay drivers must be used for this Alarm System.* Selection of the relay output is made via Jumper J3 and Jumper J4 on the mainboard. To set-up the High and Low Alarm circuits, use the following procedure.

This Procedure requires prior F/DC Converter Calibration. Section 3.2.

Procedure:

Equipment Required:

1. Frequency generator
2. Ohmmeter

- Step 1 Select the frequency of the full scale flow rate from the data sheet that accompanies the flowmeter.
- Step 2 Determine percentage of flow for activation of the alarms. (Factory settings are 90% for activation of high alarm and 10% for activation of low alarm).
- Step 3 Select NC or NO output by inserting Jumper J4 to the appropriate positions on the mainboard.
- Step 4 If unit has magnetic or pulse input, inject frequency of 10% or desired flow rate at terminals 9 and 10 of terminal strip TB1 on rear panel. If unit has LFA, then a sine wave of approximately 3 to 5 volts p-p, at a frequency of 10% flow rate, should be applied across C10 on LFA module.
- Step 5 Connect ohmmeter to terminals 1 and 2 of terminal strip TB1 on rear panel. *NOTE: The placement of Jumper 4 on the mainboard determines whether terminal 2 is the NC or the NO connection. Jumper J4 must be installed in one position or the other.*
- Step 6 Adjust R5 on the Hi/Lo Alarm (02D82541) module until the relay output changes. The ohmmeter will indicate the change of the output connection.
- Step 7 Select NC or NO output by inserting Jumper J3 into the appropriate positions on the mainboard.
- Step 8 Connect ohmmeter to terminals 3 and 4 on terminal strip TB1 on rear panel.
- Step 9 If unit has magnetic or pulse input, inject a frequency of 10%, or desired flow rate at terminals 9 and 10 of TB1 on rear panel. If unit has LFA, then a sine wave of approximately 3 to 5 volts p-p, at a frequency of 90% of flow rate, should be applied across C10 on LFA module. *NOTE: Jumper J3 must be installed in either the NC or the NO position).*

- Step 10 Adjust R4 on the Hi/Lo Alarm (02D82541) module until the relay output changes. Observe the ohmmeter for the change.
- Step 11 Disconnect test equipment and connect external DC/AC voltage to terminals 1 and 3 of TB1 on the rear panel. Connect flowmeter inputs to terminals 9 and 10.

3.7 Voltage to Current Converter Adjustment Procedures.

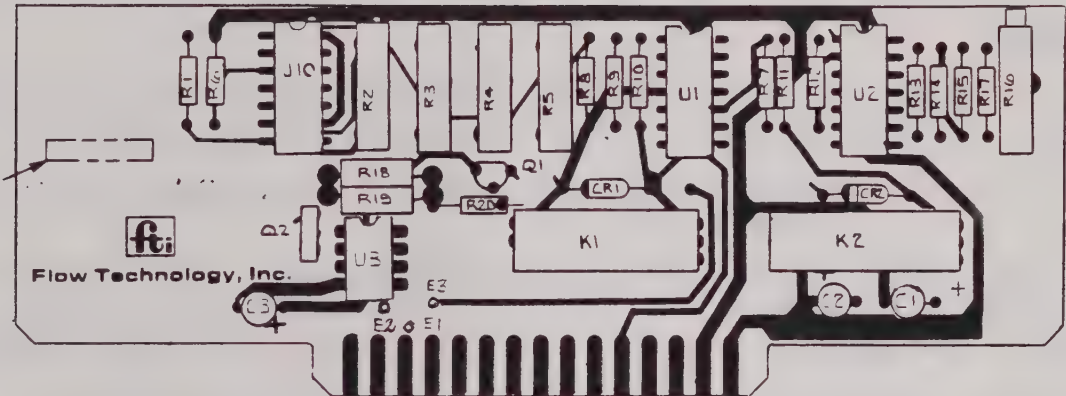


FIGURE 10. 10-50mA H/L ALARM ASSEMBLY (02-82541-05)

NOTE: This procedure requires prior F/DC Converter Calibration. The voltage to current converter accepts the 0-10 VDC from the F/DC converter and converts it to a current of 4-20mA or 10-50mA or a 1 to 5 VDC analog output that is proportional to the flow rate of the flow meter.

The maximum allowable load for the V-I converter is 600 ohms for 20mA or 250 ohms for 50mA.

Equipment Required:

1. Digital Multimeter (DMM) to read current and voltage in correct range for 5 VDC and 50mA or 20mA depending on users output.

Step 1. Using the formula given, calculate the current and/or voltage output of the V-I converter. To use the formula for voltage output substitute V_o for mA in equation.

$$\text{mA output} = \left(\frac{\text{point frequency}}{\text{max frequency}} \right) (\text{Max mA output} - \text{Min. mA output}) + \text{Min mA output}$$

where:

mA output = Current output at a given flow rate.

Max mA output = Current output at Max flow rate 20mA or 50mA.

Min mA output = Current output at zero flow rate 4mA or 10mA.

Max frequency = Freq. associated with max flow rate

Point frequency = Freq. of internal calibration circuit of Econo-line

EXAMPLE :

Given a flow meter whose max flow rate is 20 GPM @ 1751.2 Hz, calculate the current output using internal cal circuits for 4-20mA operation.

NOTE: Procedure for determining Cal freq. can be found in F/DC converter calibration Para. 3.2.

$$\left(\frac{1600}{1751.2} \right) (20-4) + 4 = 18.62\text{mA} \quad \left(\frac{1600}{1751.2} \right) (5-1) + 1 = 4.655 \text{ VDC}$$

- Step 2 Move Jump 2 on main board to correct location. See drawing 63D82539.
- Step 3 Connect a digital volt meter to pin 14 of U2 on V-I Converter.
- Step 4 Turn power on.
- Step 5 Adjust R3 to give a reading of 1.000 VDC on DMM.
- Step 6 Depress calibrate button on front panel. Adjust R2 to give a reading of 4.655 VDC on DMM.
- Step 7 Disconnect DVM from pin 14 of U2, place DMM in current mode and connect it to Pin 5 of TB1 on rear panel of unit.
- Step 8 Depress calibrate button on front panel and adjust R16 to give a reading of 18.62mA DC. Release Cal button.
- Step 9 Adjust R3 to give a reading of 4.00 mA DC.
- Step 10 Depress Cal button and adjust R2 for 18.62 mA; release cal button. Repeat steps 9 and 10 until max and min currents are achieved. Usually about two repeats should do it.
- Step 11 Turn power off and disconnect DMM. The V-I Converter is now field calibrated.

SECTION IV. THEORY OF OPERATION

4.1 General.

The Econo-Line Totalizers and Indicators consist of modular plug-in printed circuit boards. The modules available are:

- a. Main Board
- b. Pre-Amplifier
- c. Frequency to DC Converter
- d. Scaler Board
- e. V/I - Hi/Lo Circuit Board
- f. LFA Pre-Amplifier (Option)
- g. K-factor divider (Option)

The model and the options selected will determine the configuration of the individual unit. Table 3 lists the standard components provided in the various models.

TABLE 3
Model Components

Model	Analog Meter	Digital Meter	Non Reset Totalizer	Reset Totalizer	F/DC	Scaler/KFD
SRI-1	X				X	
SRI-2		X			X	
SPC-1			X		X	X
SPC-2			X	X	X	X
SRT-1	X		X		X	X
SRT-1R	X			X	X	X
SRT-2		X	X		X	X
SRT-2R		X		X	X	X

Figure 6 is a Block Diagram of the Econo-Line Totalizers and Indicators. All of the available circuits are shown. Refer to Table 2 for the individual configurations.

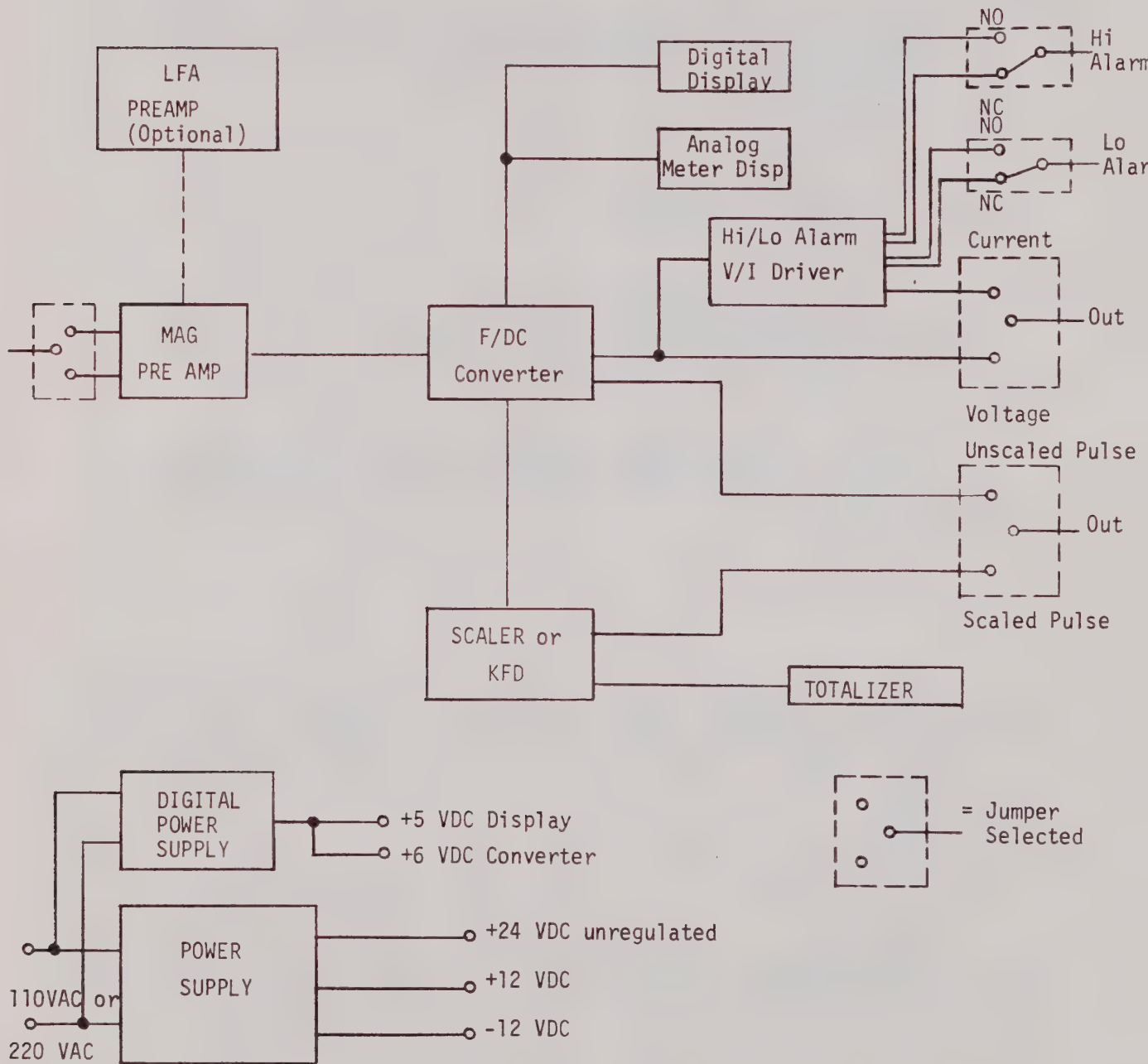


FIGURE 6
BLOCK DIAGRAM (SIMPLIFIED)

4.2 Printed Circuit Board Descriptions.

A. Mainboard - Drawing 63D82539

The mainboard acts as a host for all other printed circuit boards, provides the unit power, has the rear panel barrier terminal connector on it and has a connector to interface the front panel indicators and adjustment potentiometers.

Power Supply

Input Power is selectable. Transformer, T1 can be connected for an input of 120 VAC or 230 VAC, 50 or 60 Hz.

Options Selectable by Mainboard Jumpers

Jumper 2 - Allows the analog output signal to come from the frequency-to-DC Converter board as an analog voltage signal (0-10 VDC) or from the voltage/current driver, Hi/Lo limit board as an analog current signal (4-20mA or 10-50mA).

Jumper 1 - Allows selection of the pulse output from the frequency-to-DC converter board representing a pulse corresponding to input signal frequency, or the pulse output from the scaler board, representing a pulse corresponding to the totalized flow.

Jumper 3 - Allows selection of either a normally closed or normally open Hi limit output from the voltage/current, Hi/Lo limit board.

Jumper 4 - Allows selection of either a normally closed or normally open Lo limit output from the voltage/current, Hi/Lo limit board.

B. Pre-amplifier - Drawing 63D82540

The pre-amplifier can accept voltage signals from a transducer from 5 mV to 10V peak-to-peak.

The pre-amplifier board may be replaced with the optional modulated-carrier amplifier board to receive inputs from a modulated-carrier pickoff.

C. Frequency-to-DC Converter - Drawing 63D82542

The frequency-to-DC converter accepts the output from the pre-amplifier and converts the pulse train input into DC output voltage which is proportional to the frequency of the input. This board also has a calibration frequency oscillator circuit as well as the meter calibrate circuit. The board provides a shaped pulse train output to the rear panel pulse out terminal and a shaped pulse train to the Scaler Board.

Calibration Frequency

A correct calibration frequency must be selected using the calculation routines for the specific model in use. (Refer to F/DC calibration). The calibration frequency selected is applied by depressing the number on the 8-position rocker switch (S1) corresponding to that frequency as shown in Table 4.

Analog Output Scaling

Once the calibration frequency has been selected, refer to Table 4 to obtain the values necessary for R_{20} and C_8 . These components determine the correct frequency-to-DC scale factor for the Analog output and set the frequency response of the unit.

TABLE 4
ANALOG OUTPUT SCALING

Rocker Switch Position	Freq.	Resistor R_{20}	Values of C_8 Based on Frequency Response			
			1000 Hz	100 Hz	10 Hz	1 Hz
1	50 Hz	2.8 M Ω	100 pf	.001 μ fd	.01 μ fd	.1 μ fd
2	100 Hz	1.5 M Ω	270 pf	.0027 μ fd	.027 μ fd	.27 μ fd
3	200 Hz	698 K Ω	680 pf	.0068 μ fd	.068 μ fd	.68 μ fd
4	400 Hz	348 K Ω	.001 μ fd	.01 μ fd	.1 μ fd	1 μ fd
5	800 Hz	107 K Ω	.0027 μ fd	.027 μ fd	.27 μ fd	3 μ fd
6	1600 Hz	90.9 K Ω	.0056 μ fd	.056 μ fd	.56 μ fd	6 μ fd
7	3200 Hz	42.2 K Ω	.01 μ fd	.1 μ fd	1 μ fd	10 μ fd
8	6400 Hz	22.1 K Ω	.022 μ fd	.22 μ fd	3 μ fd	25 μ fd

Select R_{20} * as a 1% resistor and C_8 as a 25 VDC minimum working voltage. Calibration adjustments are made using the meter calibrate potentiometer and the ZERO and SPAN potentiometers on the front panel. (Refer to Calibration - Flow Rate Indicator, for details). Selection of a frequency response also sets the level of the ripple voltage in the analog output. A trade off must be made, in that, as frequency response increases the amplitude of the ripple voltage also increases. The nomograph, Table 5 can be used to determine the effects of selecting higher frequency responses.

Select R_{21} for Digital or Analog output. For Digital R_{21} value is 49.9K ohms; for Analog R_{21} value is 4.99K ohms.

* The table values for R_{20} are optional, however, a resistor of approximately the same value may be used when necessary.

D. Scaler Board - Drawing 63D82545

The scaler board accepts a shaped pulse train from the frequency to DC converter board and provides a pulse train output proportional to the number of gallons that have passed through the flow transducer. The relationship between the turbine meter calibration constant in pulses per gallon, the flow totalizer resolution in gallons or parts of gallons and the scaler board multiplier/divider setting is as follows:

- (D) = Divider setting
- (M) = Multiplier scaling
- (R) = Totalizer resolution in fractions of engineering units
- (K) = Transducer pulses per engineering units
- (D) = (K) x (R) x (Selectable from 2^h) (See Table 2 for 2^h values)

The value of (D) is set by a jumper while the multiplier scaler is set by miniature switches, S1, S2, and S3. The scaler board provides a scaled pulse to the front panel totalizer. It also provides a scaled pulse selectable at the rear panel terminal on the main board.

Calculations, jumper positions and switch settings are discussed in detail under Calibrations - Flow Totalizer.

E. V/I-Hi/Lo Limit Board - Drawing 63D82541

The Voltage-to-Current (V/I) board accepts an analog voltage input (0-10V) from the Frequency-to-DC Converter board and provides an analog output. The standard output is 4 to 20 mA current, but this can be converted to 10 to 50 mA current by the addition of a resistor, R18, or to 1 to 5 Vdc voltage by removing the jumper E2 to E1 and connecting a jumper E3 to E1 (refer to Schematic 63-82541). This provides the capability of having either a 4-20 mA current output, a 10 to 50 mA current output, or a 1 to 5 Vdc voltage output.

NOTE: Jumper 2 on the Main Board must be connected to solder eye #1 to provide these outputs, and the 0-10 Vdc voltage output is not available.

The V/I Hi/Lo limit board also provides high or low limit alarm relay signals. Relay K1 provides high limit alarm. Normally open vs. normally closed options are selected by changing jumper 3 on the main board. Relay K2 provides low limit alarm. The same normally open vs. normally closed option is available through jumper 4 on the main board.

CAUTION: RELAYS K1 and K2 CANNOT ACCEPT 110 or 220 VAC SIGNALS. EXTERNAL RELAY DRIVERS MUST BE USED FOR THIS AC ALARM SYSTEM.

F. K-factor Divider Board (KFD) - Drawing 63D82543

Divide-by-N Counter. The pulse input is applied to input-buffer transistor Q1. The output from the collector of Q1 is applied to the 6-stage synchronous counter, operating in the count-down mode, as the clock input. The counter is preset to the value set on S1 through S6 during reset. The counter decrements to zero and produces a pulse output which is applied to the monostable (U4C & U4D) and is also used to reset the counter to the preset number. Since the value preset on S1 through S6 is the K-factor, this counter produces a single pulse output each time that this preset value is decremented to zero, thus, dividing the K-factor into engineering units.

Monostable (U4C and U4D). The monostable provides a constant pulse width of approximately 20ms to drive the E/M counter via driver Q3.

Output Buffer Q2. The output from the buffer amplifier Q2 is a 10 volt peak-to-peak pulse, clamped to ground, with a pulse width of 30 milliseconds (approximately) and is applied to the driver amplifier Q3 and is also supplied to external totalizing equipment as a scaled pulse output.

Driver Q3. Transistor Driver, Q3, provides an open collector output for driving an E/M totalizer. Q3 provides a 12V pulse on the collector when connected to the external totalizer.

G. LFA-300 Pre-Amplifier - Drawing 63C82544

The LFA-300 pre-amplifier is a modulated carrier pre-amplifier. The pickoff coil of the flowmeter is part of the oscillator circuit of Q1, which oscillates at approximately 45KHz. As the rotor rotates in the flowmeter, it causes the carrier signal to be amplitude modulated. This signal is capacitively coupled via C7 to the detector stage Q2 where the carrier frequency is removed. Q2 output is applied via C8 and C9 to amplifier U1A where the common mode rejection produces an amplified clipped sine wave output. This distorted sine wave is applied to the input of Schmidt Trigger U1B which provides a +12VDC output pulse. The frequency of the output pulse is the same as the flowmeter frequency.

Potentiometer R14 may require adjustment in order to minimize the effects of electronic noise on the pulse output. To adjust R14, the unit should be installed with power and flowmeter attached.

Connect an oscilloscope to terminal 6 of TB1 and common to terminal 8 of TB1.

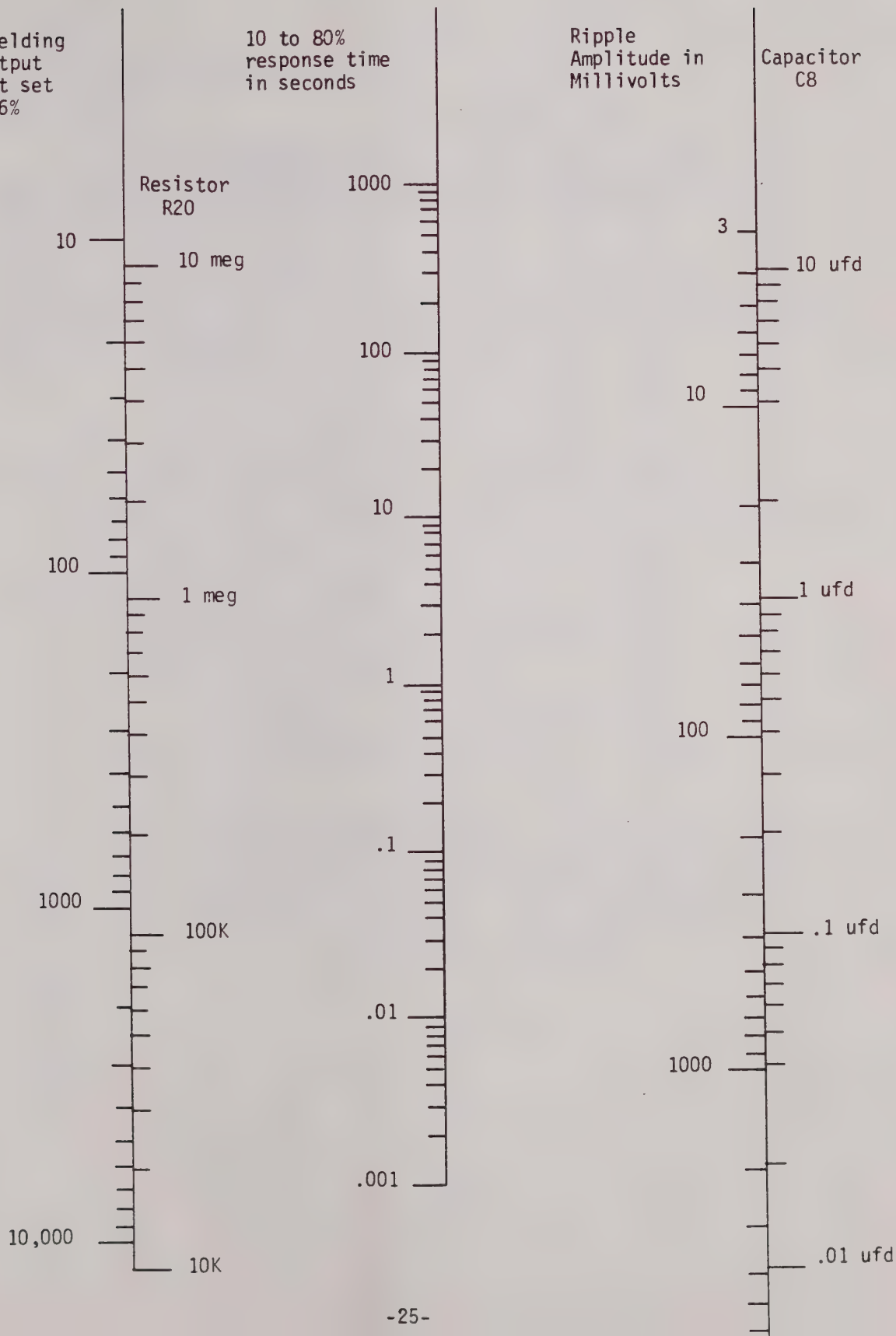
With NO flow through the flowmeter, adjust R14 clockwise until a pulse is seen on the oscilloscope screen. This pulse is noise.

Adjust R14 counterclockwise (decrease gain) until there is no pulse out with no flow through the flowmeter.

Check the pulse out with flow through the flowmeter to verify the adjustment.

TABLE 5 ANALOG OUTPUT NOMOGRAPH

Calibration
Frequency yielding
7.5 volts output
with span pot set
to approx. 36%
full travel



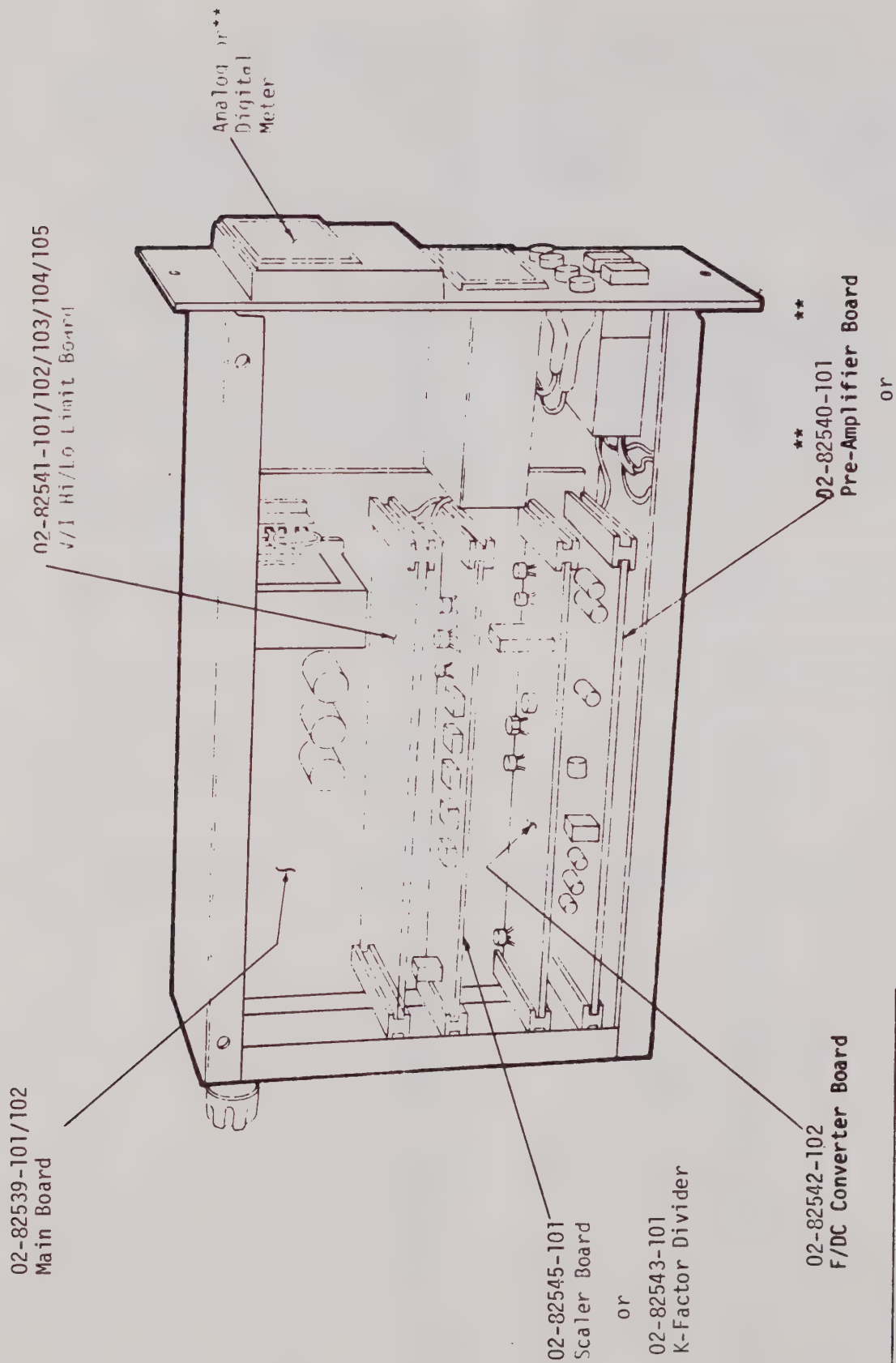


Figure 7 ECONO-LINE SERIES III 02-82544
Low Flow Amplifier Board

SECTION V. MAINTENANCE

5.1 General.

Regular maintenance is not required. Cleaning normally associated with electronic equipment is recommended.

5.2 Spare Parts

It is recommended that one set of printed circuit modules be maintained as spares for each rack panel of indicators and/or indicator totalizers.

Table 7 is the recommended Spare Parts list.

5.3 Troubleshooting.

Printed circuit board replacement provides the most expedient repair of failed units. Table 6 is a troubleshooting Guide listing some of the most common causes of trouble. The symptom, the probable cause, and the corrective action to be taken for each symptom is listed.

TABLE 6
TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
(1) Power light does not come on when power switch is turned on	Blown fuse or Pilot lamp burned out	Replace fuse or Pilot Lamp
(2) No +24VDC, +12VDC, or -12VDC on Bus	Power Supply Module defective	Replace Power Supply Module
(3) Meter does not indicate when CAL push-button is pressed.	F/DC Module defective or Panel Meter defective	Replace F/DC Module Replace panel meter
(4) Meter does not indicate in normal but indicates in CAL	No flowmeter input or Pre-Amplifier defective	(Replace flowmeter) Check J5 pin A & B for input. Replace pre-amp module

TABLE 7
SPARE PARTS LIST

ITEM	QTY*	MODEL	PART NUMBER	DESCRIPTION
1	1	All Units	02-82539-101	Main Board, Econoline
2a	**	A2,A3	02-82540-101	Preamplifier Board
2b		A1L,A1H	02-82544-101	LFA 300 Board
3		All	02-82542-101	F/DC Converter Board
4a	**	M	02-82543-101	K-Factor Divider Board
4b		SRT,SPC (No M)	02-82545-101	Scaler Board
5a	**	H/L	02-82541-101	HI/LO Alarm Board
5b		B	02-82541-102	V/I Converter, 4-20mA
5c		C	02-82541-103	V/I Converter, 10-50mA
5d		B, H/L	02-82541-104	HI/LO Alarm, V/I Converter, 4-20mA
5e		C, H/L	02-82541-105	HI/LO Alarm, V/I Converter, 10-50mA
6	1	All	21-82032-01	Switch, Mon DPDT Cal
7	1	All	21-82033-01	Switch, Alt SPDT Power
8a	**	SRT, SPC	24-12602-01	E/M Counter, Non-Reset, 6 digit
8b		SPC	24-12739-01	E/M Counter, Resettable, 6 digit
8c		P8 option	24-80494-01	E/M Counter, Non-Reset, 8 digit
9a	**	SRI-1, SRT-1	24-82031-01	Meter, Analog
9b		SRI-2, SRT-2	24-82045-01	Meter, Digital
10	2	All	23-12050-01	Fuse, Fast Blo 1 Amp

NOTES:

- * All models do not contain all components. Check model number to determine which components are required.
- ** Any one unit will contain only one, if any, of the items of like number

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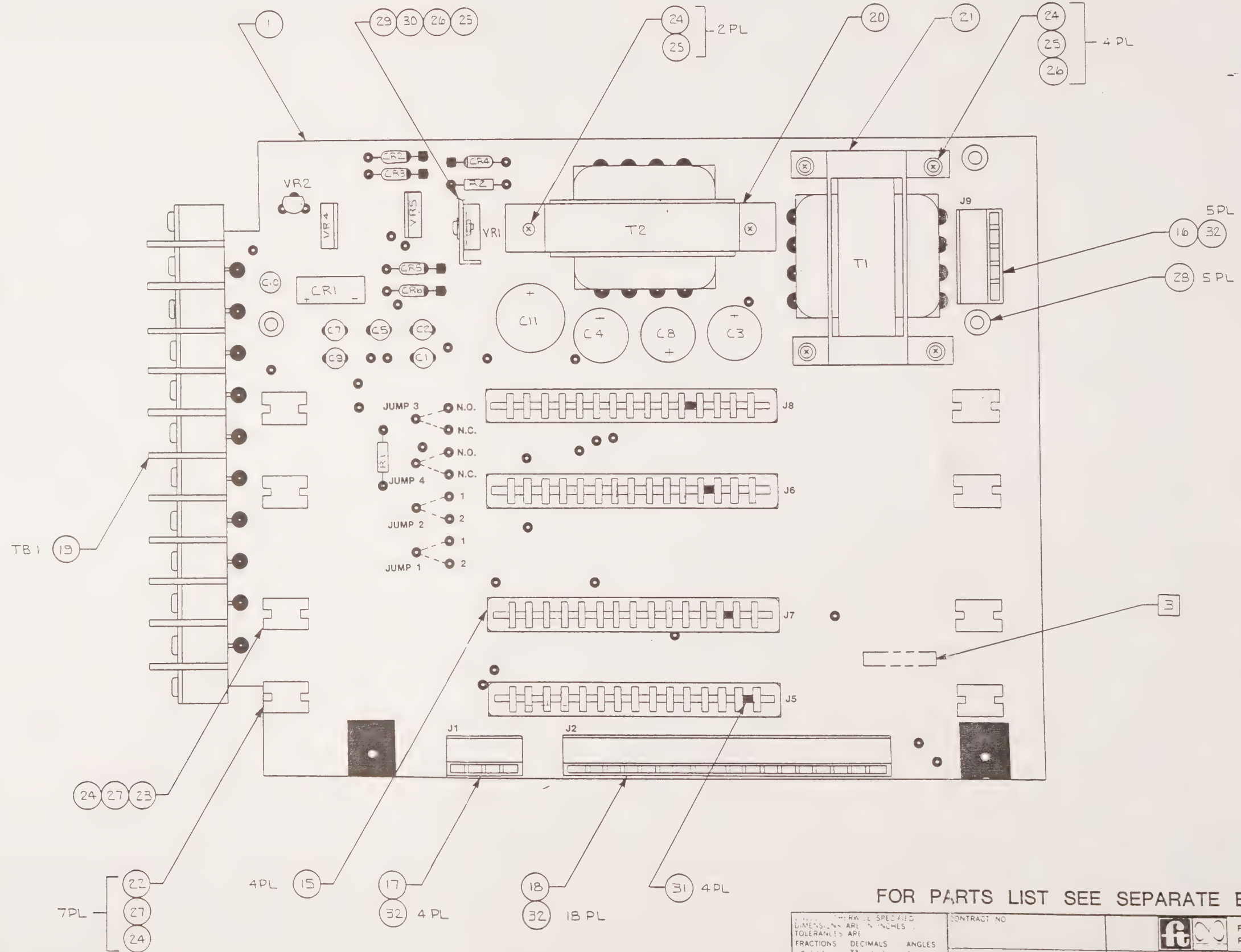
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ZONE	DESCRIPTION		
C	REV AND REDRAWN PER ECR 7091 W.O.#17 JEM	7-7-81	John Duff

NOTES

- UNLESS OTHERWISE SPECIFIED:
"•" ON "U" CONFIGURATION INDICATES PIN 1.
CLEAN WITH NON-RESIDUE, NON-CORROSIVE ROSIN-RESIDUE REMOVER.
CUT ALL LEADS 1/16" MAX FROM BOARD.
USE SN63 ROSIN CORE SOLDER.
ALL PART NUMBERS AND POLARITY INDICATORS OF RADIAL LEAD COMPONENTS TO BE VISIBLE AFTER ASSEMBLY.
- REF DESIG ARE FOR REF ONLY AND DO NOT APPEAR ON PART.
- PRIOR TO ASSEMBLY INK STAMP PREFIX, DWG SIZE, BASIC DWG NO. AND APPLICABLE DASH NO. IN AREA INDICATED AS FOLLOWS:

xx x xxxxx - xxx

— DASH NO.
— BASIC DWG NO.
— DWG SIZE
— PREFIX

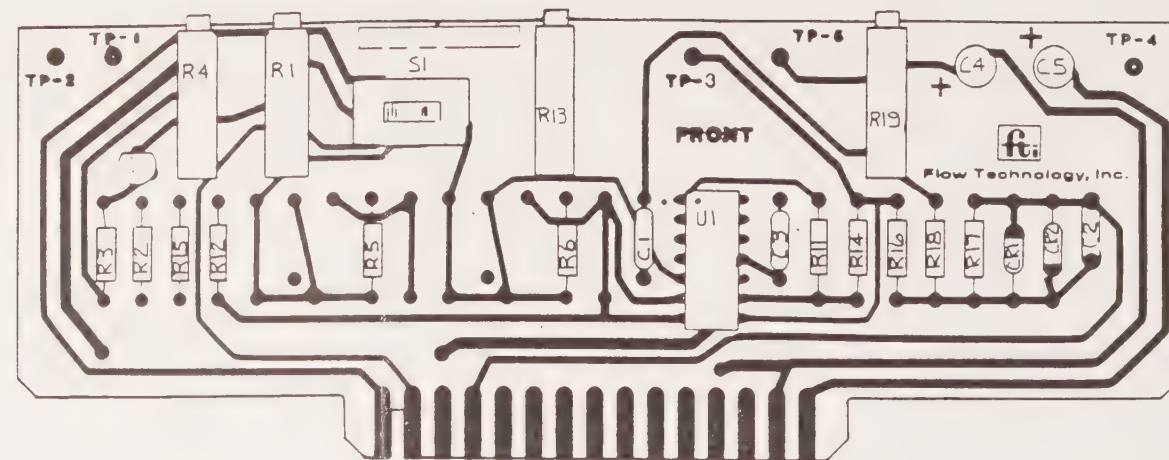


FOR PARTS LIST SEE SEPARATE B/M

CONTRACT NO. APPROVALS DATE DRAWN E KNOWLES 10-23-80 CHECKED J BONA 9-23-80 B 1STMAN 11-04-80		FLOW TECHNOLOGY, INC. PHOENIX ARIZONA
MATERIAL FINISH APPLICATION		PCB ASSEMBLY, MOTHERBOARD - ECONO-LINE, SERIES III
SIZE CODE IDENT NO. DRAWING NO. D 18316 02082539		SCALE 2 x 1 SHEET 1 OF 1

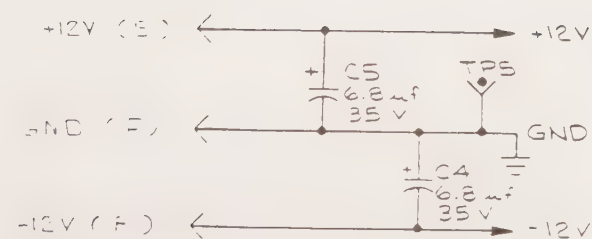
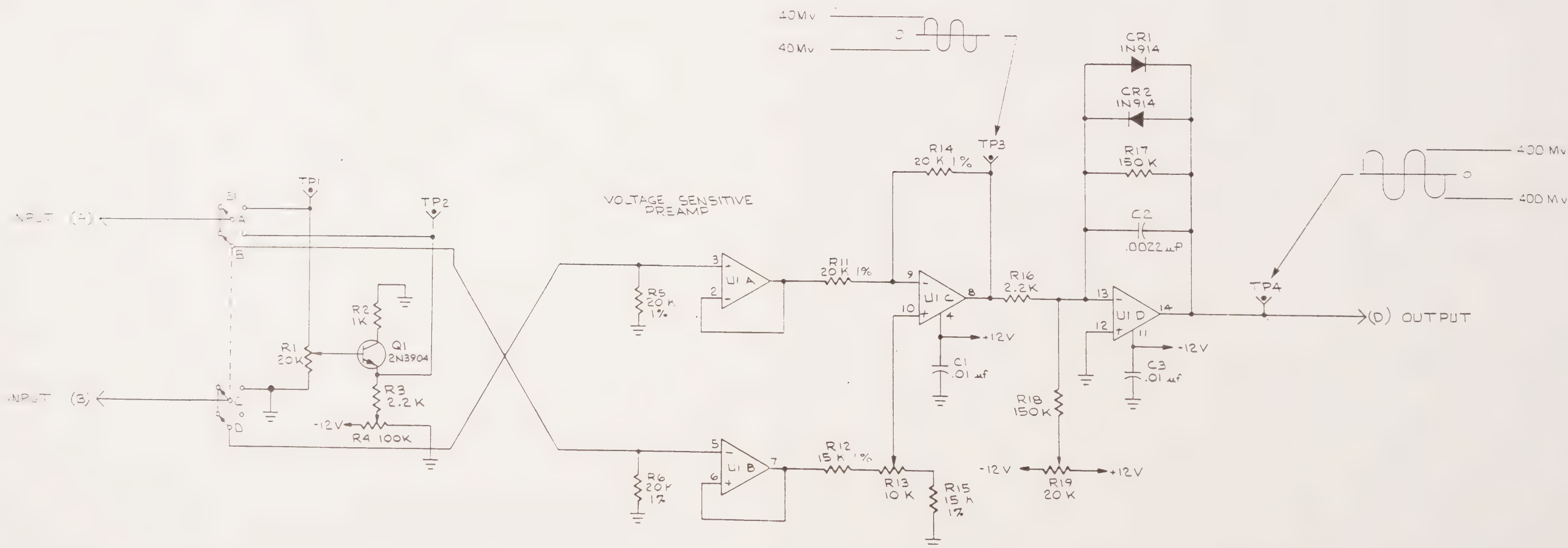
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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± 1/64 .XX ± .010 ± 30° .XXX ± .005			CONTRACT NO.   FLOW TECHNOLOGY, INC. PHOENIX ARIAZONA	
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FINISH			SCHEMATIC, MOTHERBOARD— ECONO-LINE, SERIES III	
DO NOT SCALE DRAWING			SIZE	CODE IDENT NO. DRAWING NO.
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U₁ IS TLO84CN

ALL WAVE FORMS ARE TAKEN WITH 25MV INPUT SIGNALS.



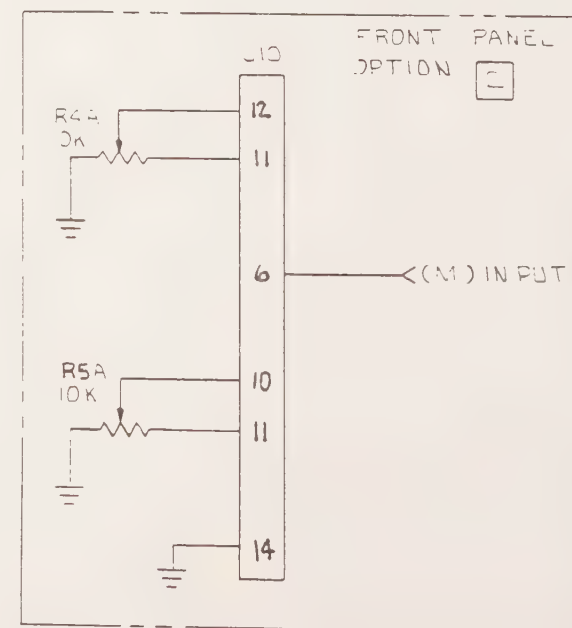
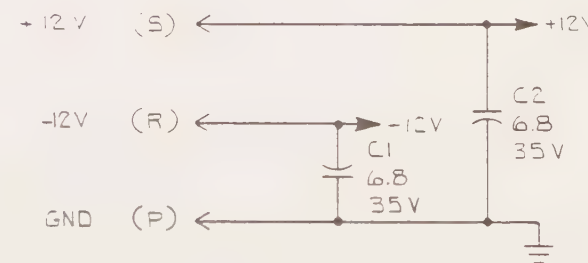
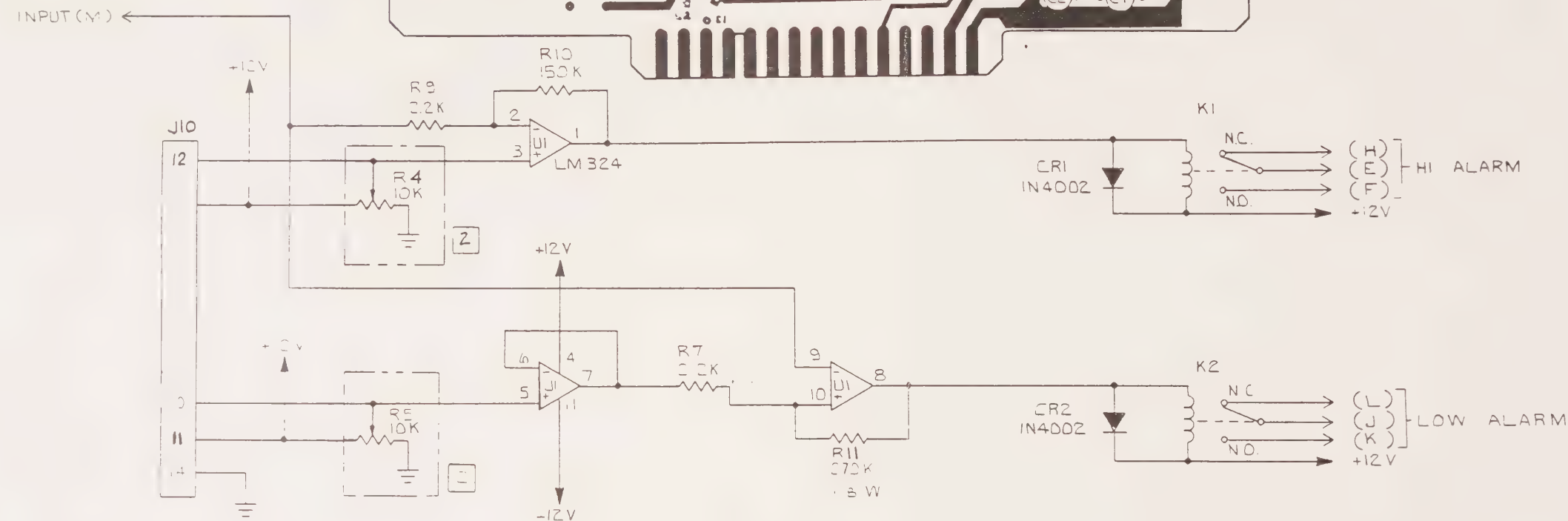
PREAMPLIFIER BOARD

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SCALE		SHEET OF

NOTES

1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS,
1/4 W 10%.
ALL CAPACITANCE VALUES ARE IN
MICROFARADS.

2. FOR FRONT PANEL OPTION REMOVE
R5 AND R4 AND REPLACE WITH
R5A AND R4A FOR FRONT PANEL
CONTROL.



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DESCRIPTION						

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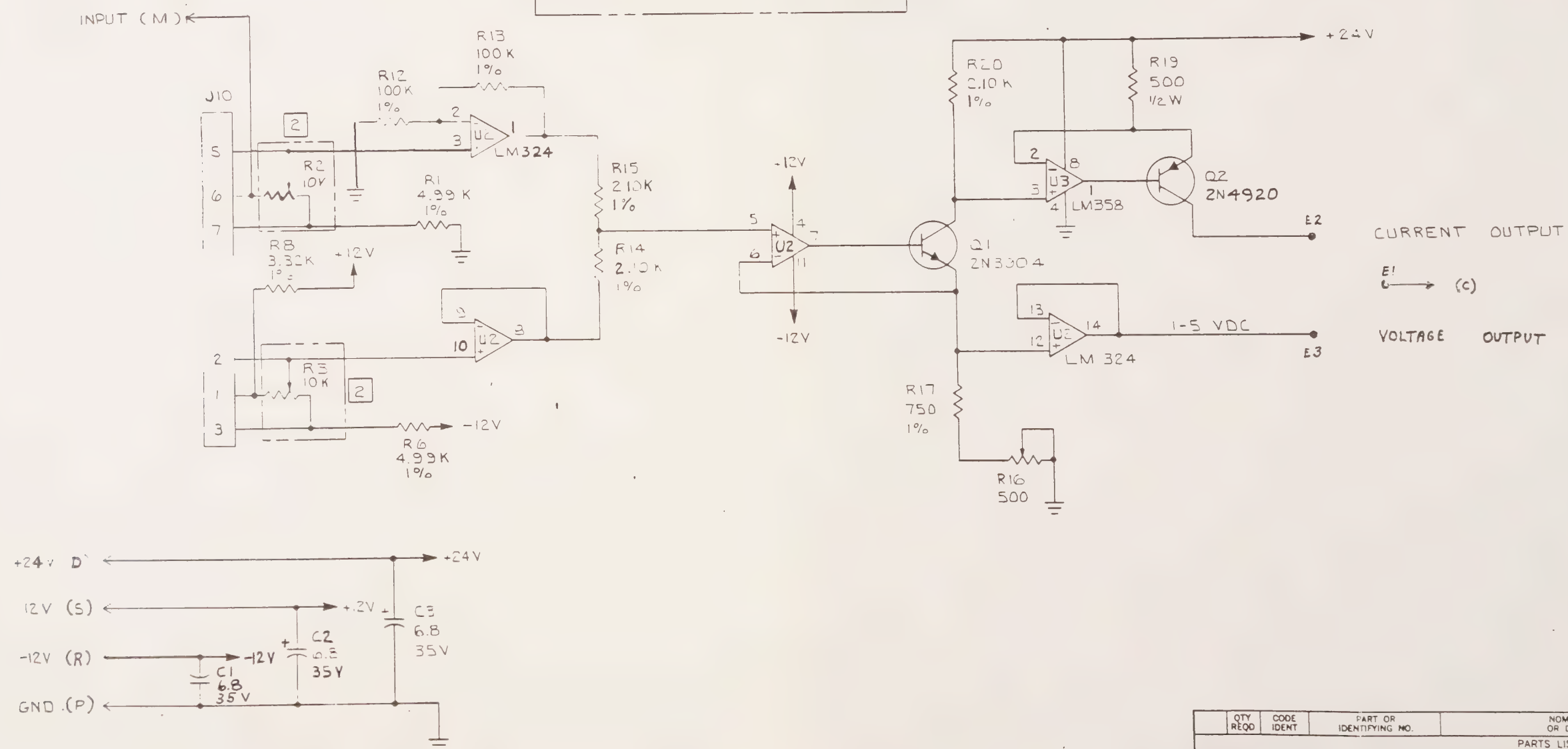
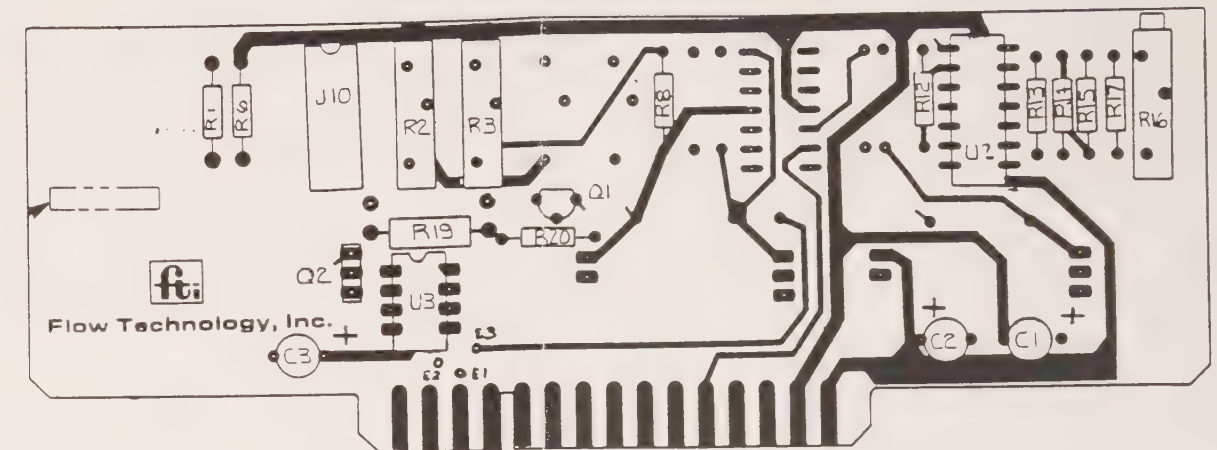
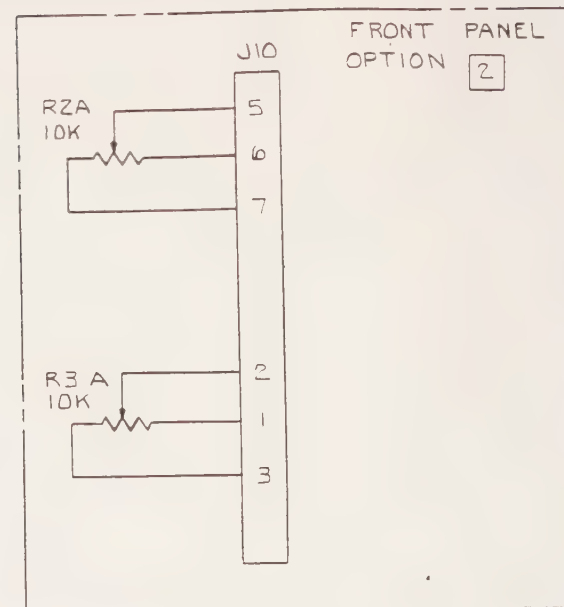
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APPLICATION	

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FINISH				CHECKED <i>[Signature]</i>		7-13-81			
				<i>[Signature]</i>		7-13-81			
DO NOT SCALE DRAWING				SIZE		CODE IDENT NO.		DRAWING NO.	
				D		18316		63082541-0	
				SCALE NONE				SHEET 1 OF 1	

1. UNLESS OTHERWISE SPECIFIED, . . .
ALL RESISTANCE VALUES ARE IN OHMS
1/8 W 10%
ALL CAPACITANCE VALUES IN MICROFARADS

2 FOR FRONT PANEL OPTION REMOVE R2 AND R3 PLACE R2A AND R3A ON FRONT PANEL FOR PANEL OPERATION.



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	
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APPROVALS			DATE	
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CHECKED John Ogle			5-8-81	
Ernie Cook			7-15-81	
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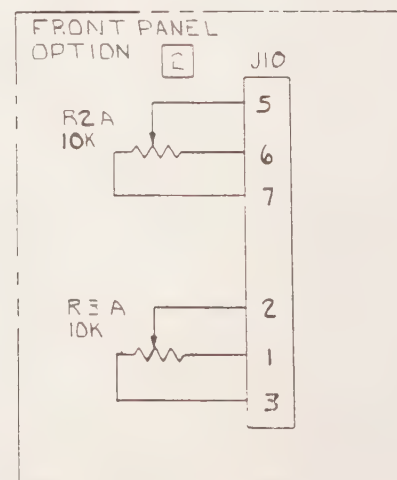
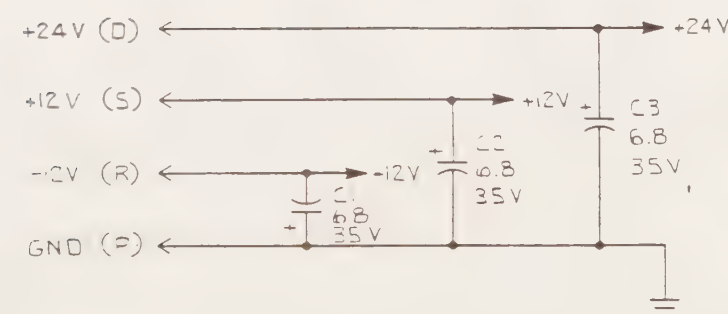
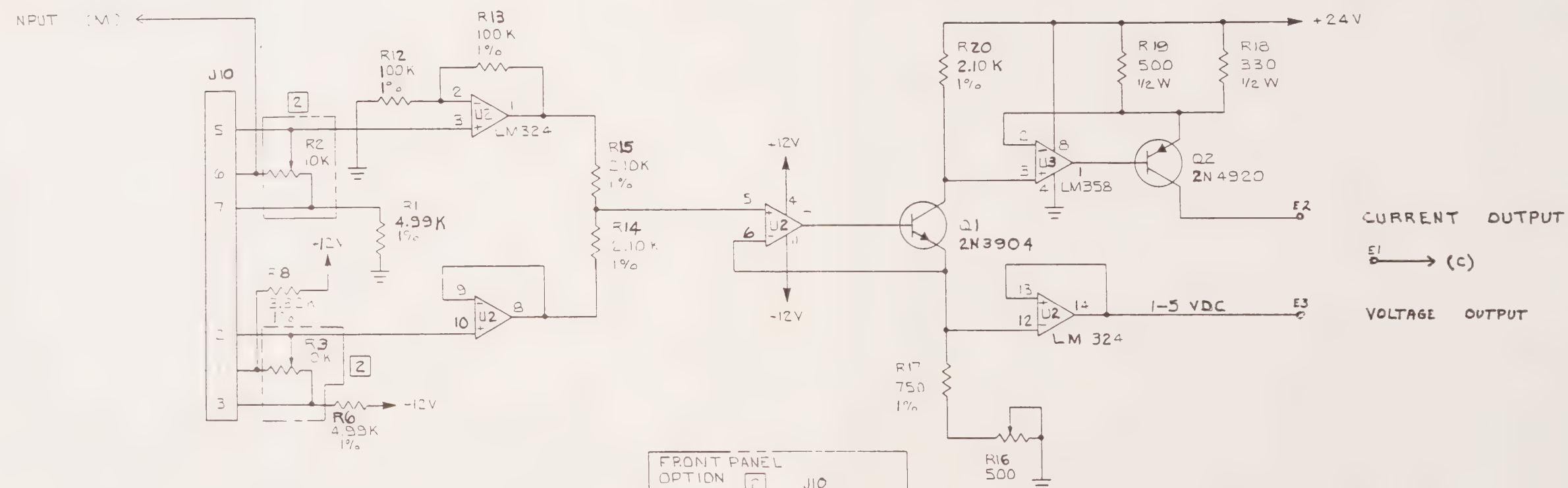
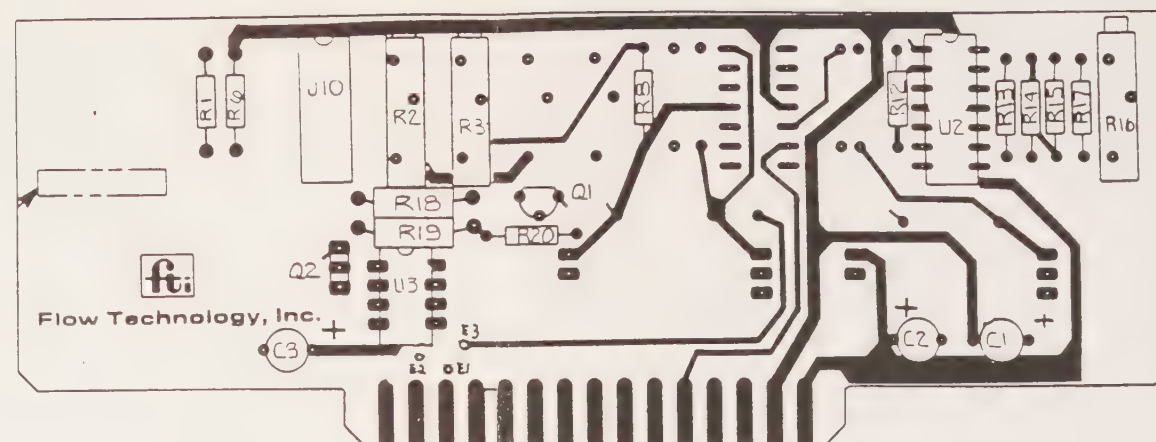
NOTES

1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTANT VALUES ARE IN OHMS
1/8 W 10%.
ALL CAPACITANCE VALUES IN MICROFARADS.

2 FOR FRONT PANEL OPTION REMOVE R2 AND R3 AND PLACE R4 AND R5A ON FRONT PANEL.

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



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LAST		REF		DESIG		USED

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C	R	Q	CR	U	J	
REF DESIG NOT USED						

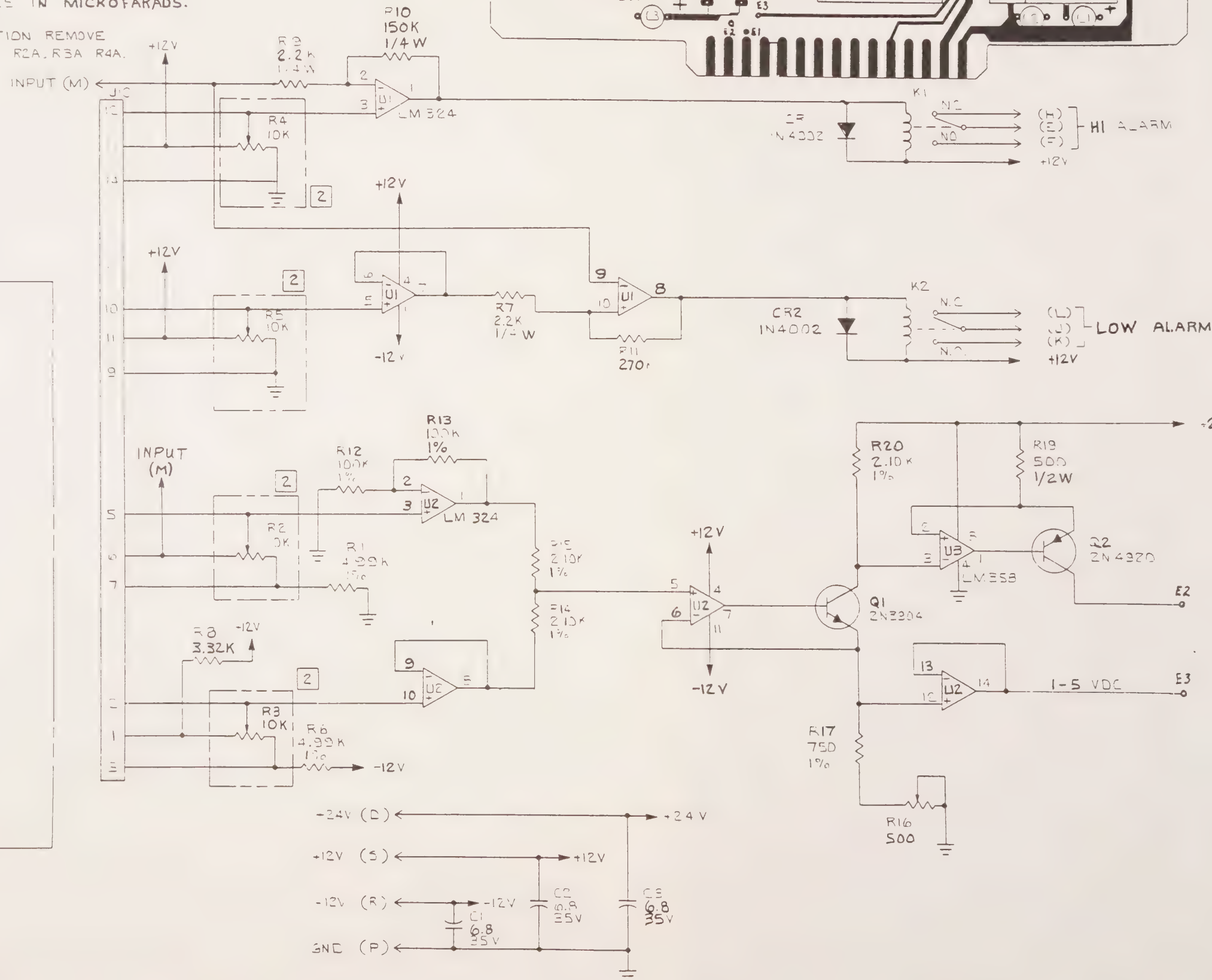
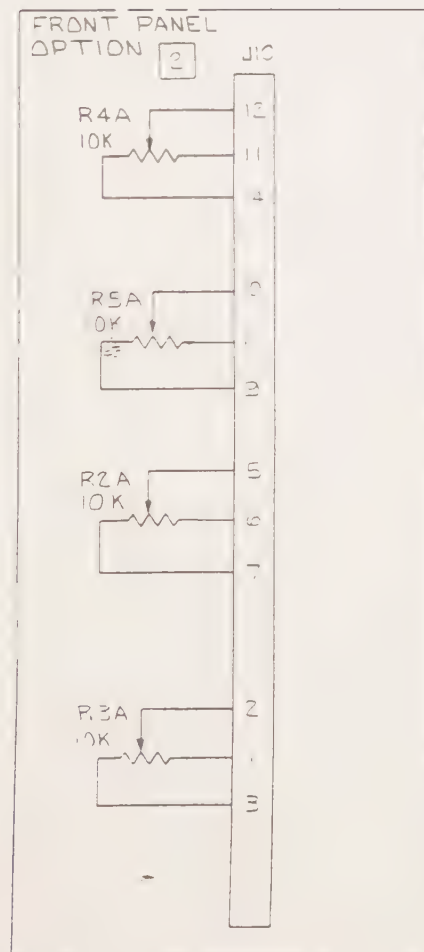
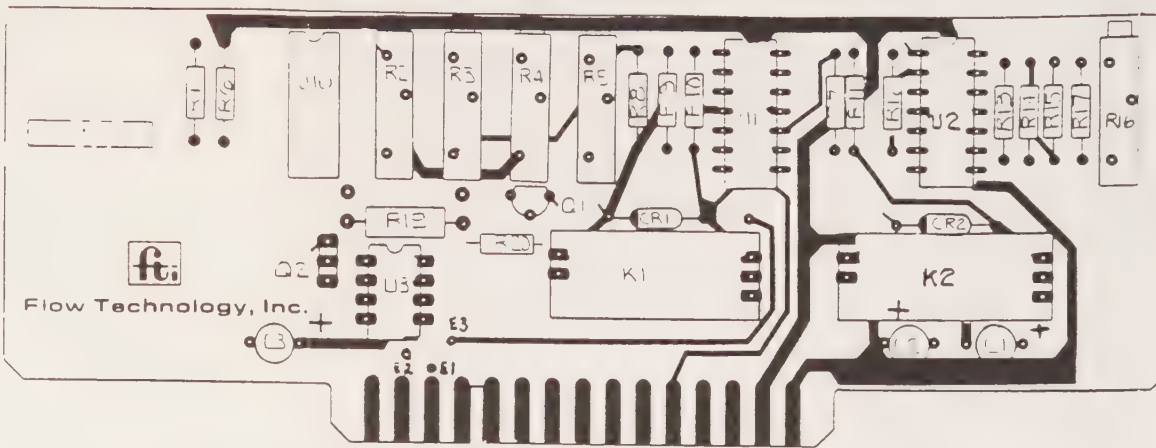
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		MATERIAL	
		FINISH	
0205254 - 03		02052532	
NEXT ASSY		USED ON	
APPLICATION		DO NOT SCALE DRAWING	

PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST	
CONTRACT NO.	 FLOW TECHNOLOGY, INC. PHOENIX ARIZONA
APPROVALS DATE	SCHEMATIC VOLTAGE TO CURRENT BOARD D-50MA, (OPTIONAL), ECONOLINE, SERIES III
DRAWN JEMENEFFEE 4-28-81	
CHECKED [Signature] 5-8-81	
[Blank]	
SHEET 1 OF 1	SIZE CODE IDENT NO DRAWING NO.
	D 18316 63082541-03
	SCALE NONE SHEET 1 OF 1

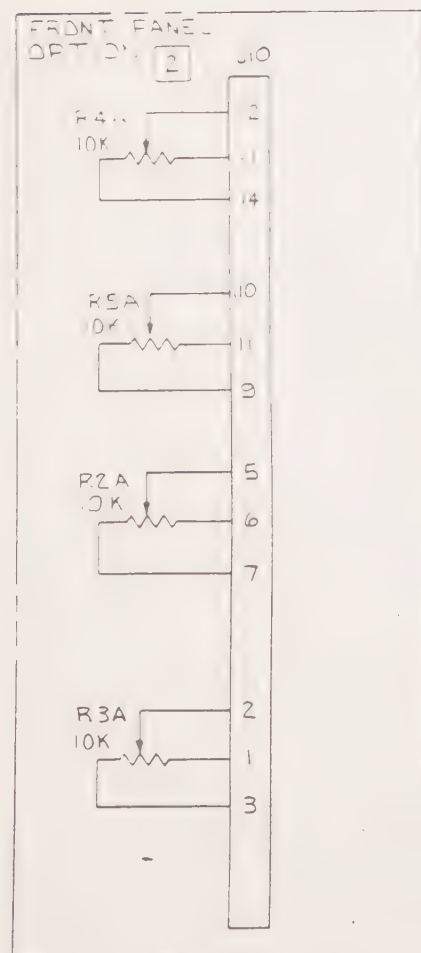
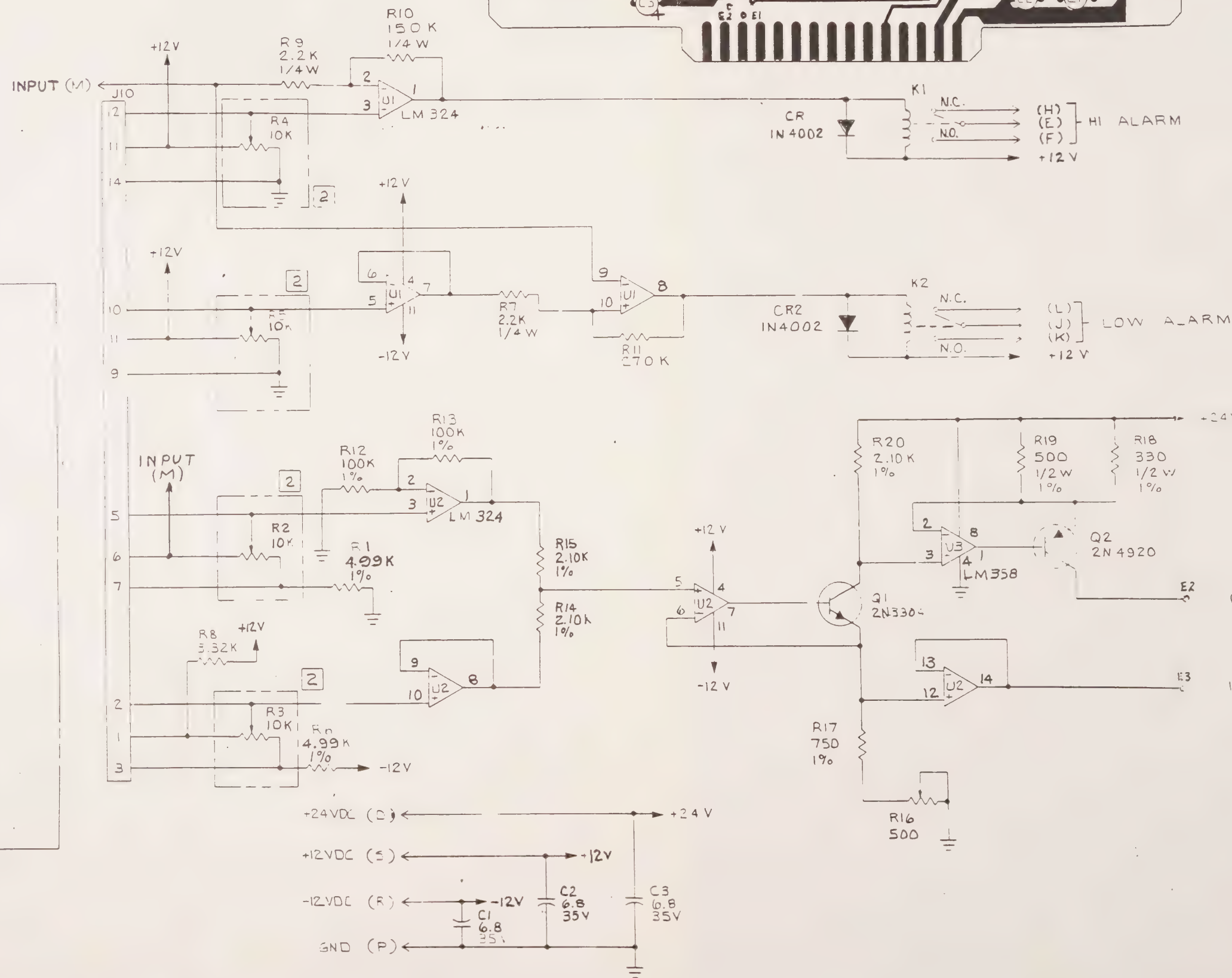
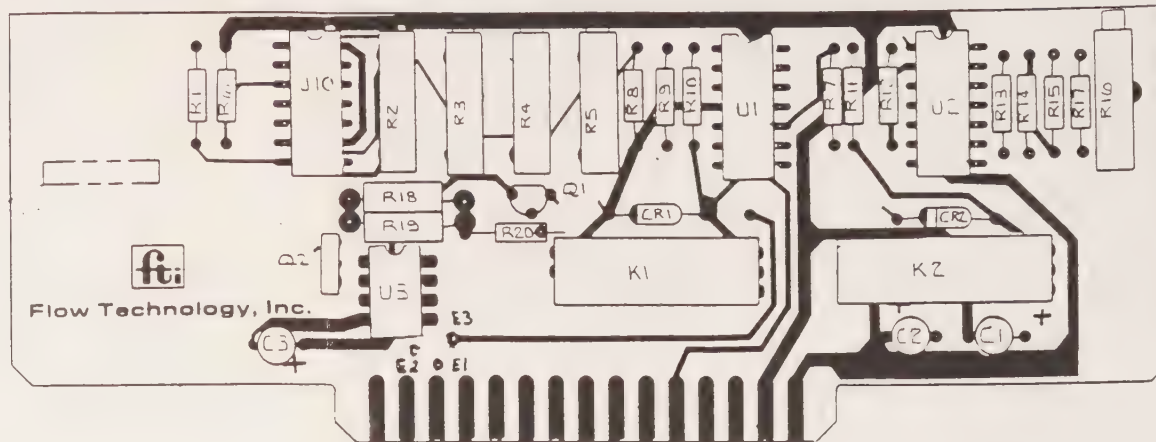
NOTES

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES IN OHMS,
1/8 W 10%
ALL CAPACITANCE VALUES IN MICROFARADS.

2 FOR FRONT PANEL OPTION REMOVE
R2, R3, R4, R5 AND PLACE R2A, R3A, R4A,
R5A ON FRONT PANEL.

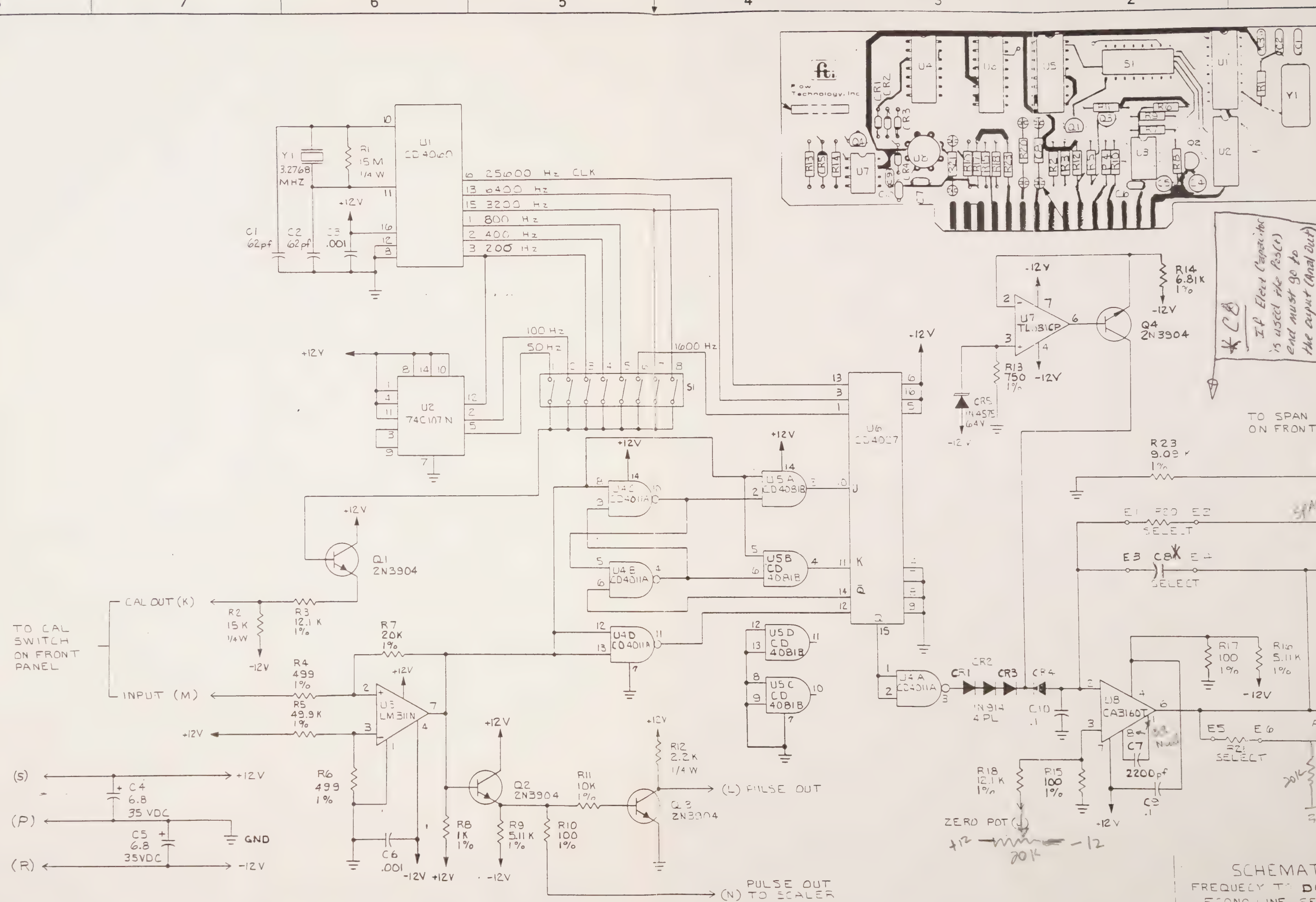


PCB ASSEMBLY
VOLTAGE TO CURRENT
4-20 MA, HI-LO ALARM
ECONO-LINE, SERIES II

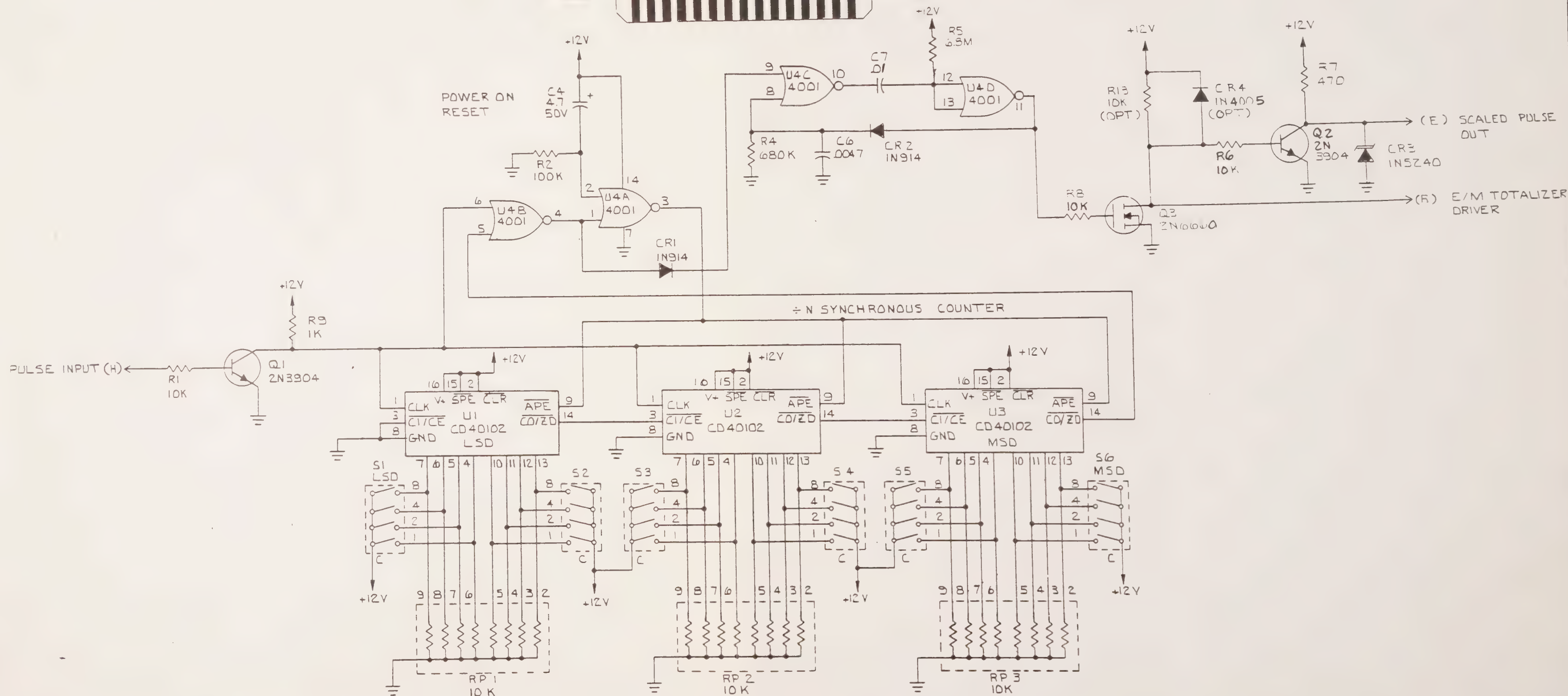
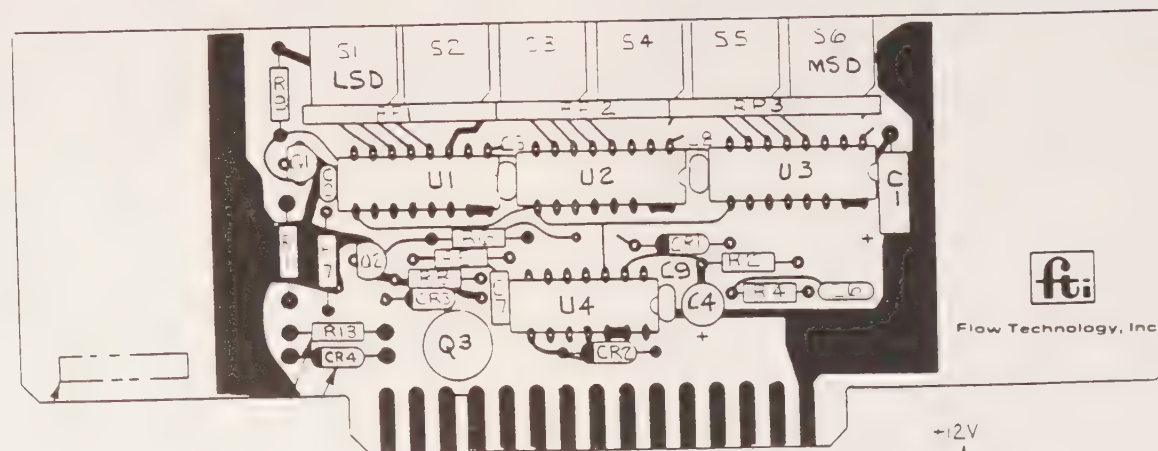


P.C.B. ASSEMBLY,
VOLTAGE TO CURRENT—
10-50 MA, HI-LO ALARM,
ECONO-LINE, SERIES III

SIZE	CODE IDENT NO.	DRAWING NO.
D	18316	02082541-103
SCALE		SHEET 1 OF 1



NOTES
UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCE VALUES ARE IN OHMS.
ALL CAPACITANCE VALUES ARE IN MICRO FARADS.



SCHEMATIC,
K-FACTOR DIVIDER BOARD
ECONO-LINE, SERIES III

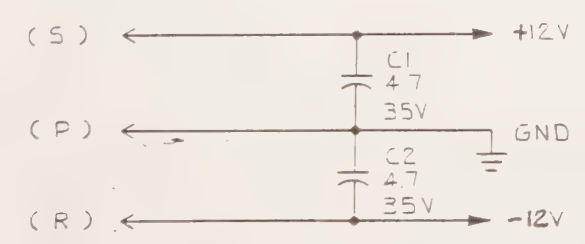
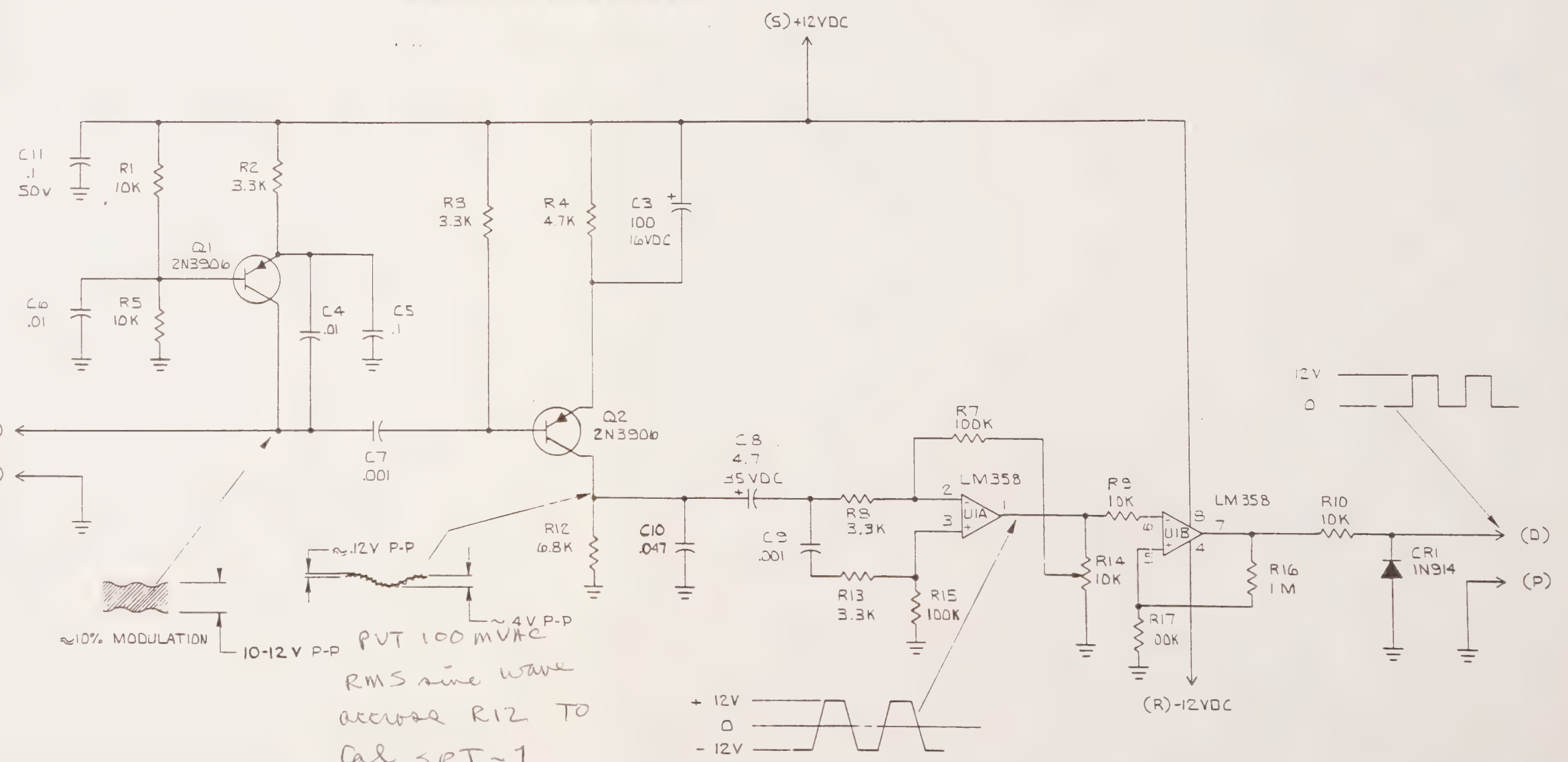
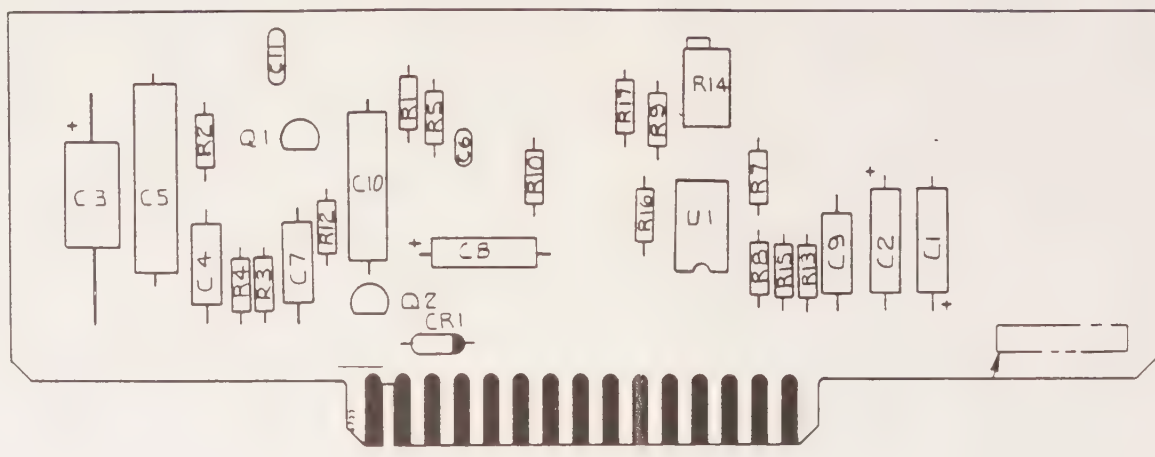
SIZE: D CODE IDENT NO. 18316 DRAWING NO. 63082543
SCALE: NONE SHEET 1 OF 1

NOTES

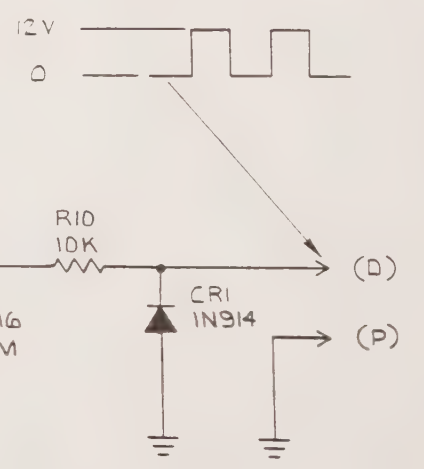
- 1. ALL RESISTANCE VALUES ARE IN OHMS - 1/4 W 10%
- 2. ALL CAPACITANCE VALUES ARE IN MICROFARAD.

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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	C	REV AND REDRAWN PER ECR 7091 W.O.#17 JEM	4-15-81	



~10% MODULATION
10-12V P-P
~4V P-P
PVT 100 MV/AC
RMS sine wave
across R12 TO
Cal SRI-1

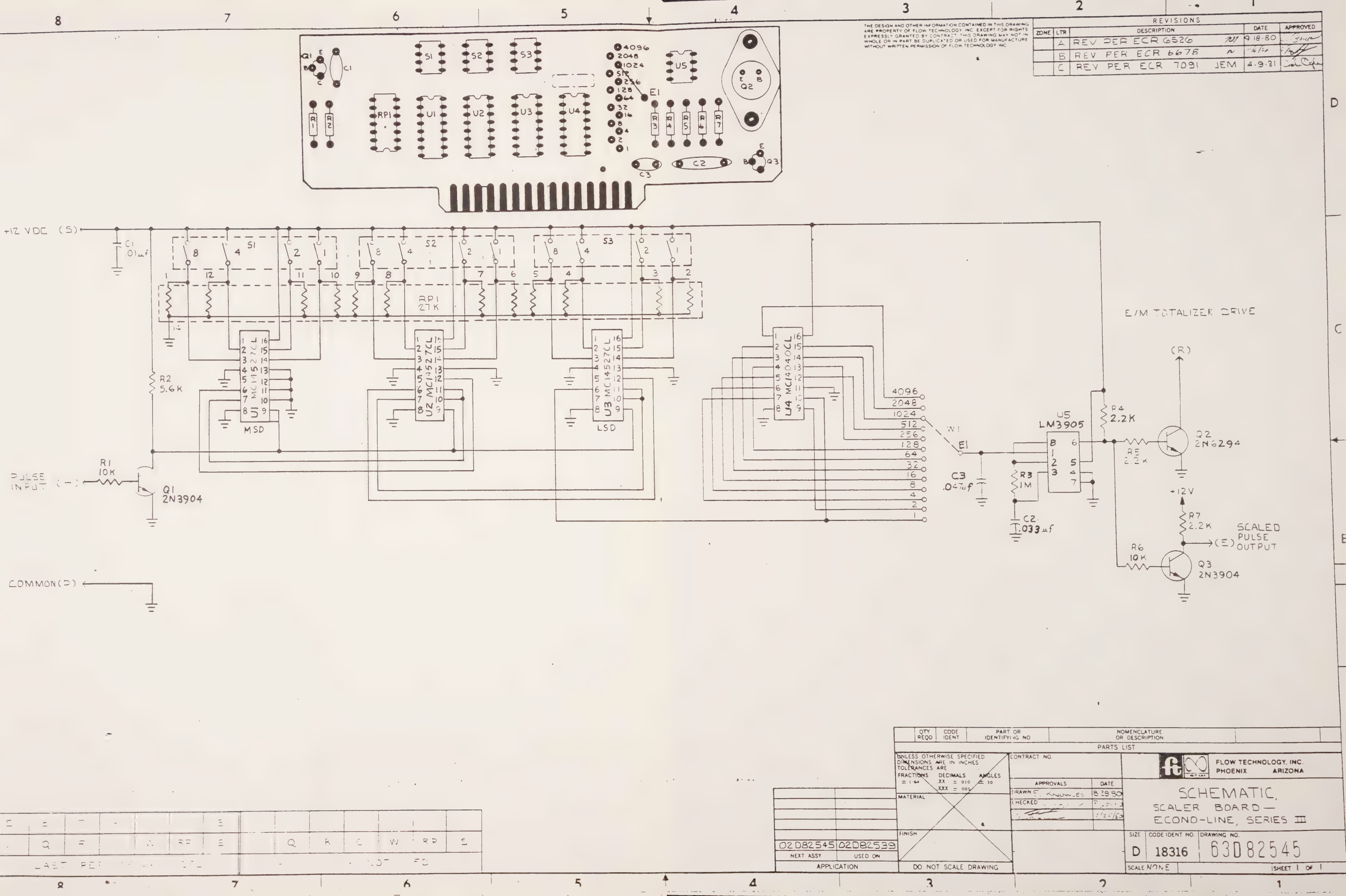


11	2	17	1	1					
C	Q	R	U	CR					
LAST REF DESIG. USED									

		6.11							
C	Q	R	U	CR					
REFERENCE DESIG. NOT USED									

NEXT ASSY	USED ON
APPLICATION	

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.	APPROVALS
FRACTIONS	DECIMALS	ANGLES	DATE
1/64	.010	30	
.XX	.010		
.XXX	.005		
MATERIAL	DRAWN M. ANDREWS 9-18-80		
FINISH	CHECKED JBDNA 9-25-80		
	B. J. T. MAN 9-25-80		
DO NOT SCALE DRAWING		SCHEMATIC, LFA-300 BOARD - ECONO-LINE, SERIES III	
SIZE		CODE IDENT NO.	DRAWING NO.
D		18316	63082544-01
SCALE NONE		SHEET 1 OF 1	



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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
A	REV PER ECR 6526	NI	9-18-80	
B	REV PER ECR 6678	N	11-6-80	
C	REV PER ECR 7091	JEM	4-9-81	

Q	R	P	E	S	W	C	R	Q	E	R	P	E	S
LAST REV. 11/25/80													

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES XX = .010 ± .001 XXX = .005 ± .001		CONTRACT NO.	
MATERIAL		APPROVALS	DATE
FINISH		CHECKED	DATE
APPLICATION		DO NOT SCALE DRAWING	
02D82545 02D82539		NEXT ASSY USED ON	
SCALE NONE		SHEET 1 OF 1	

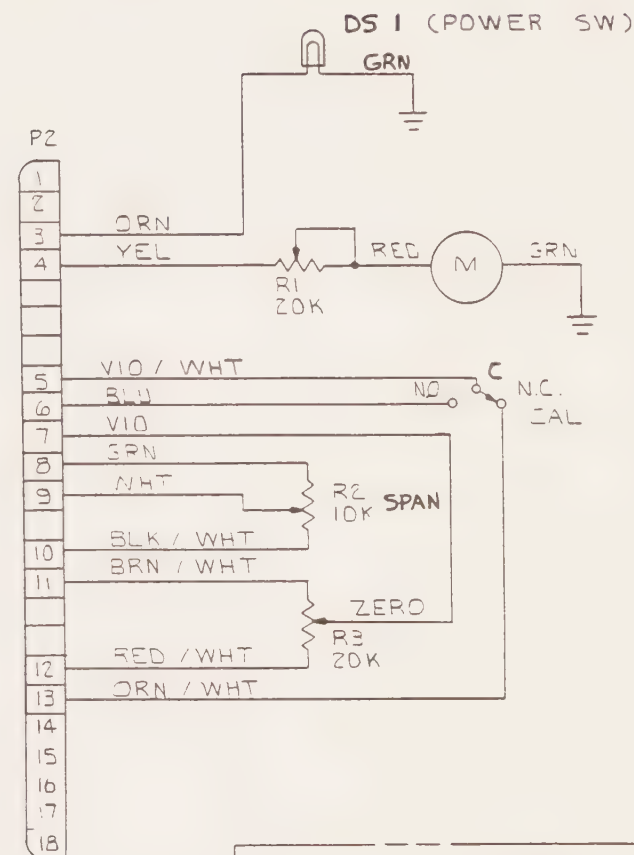
FLOW TECHNOLOGY, INC.
PHOENIX ARIZONA

SCHEMATIC,
SCALER BOARD—
ECONO-LINE, SERIES III

SIZE D CODE IDENT NO. 18316 DRAWING NO. 63D82545

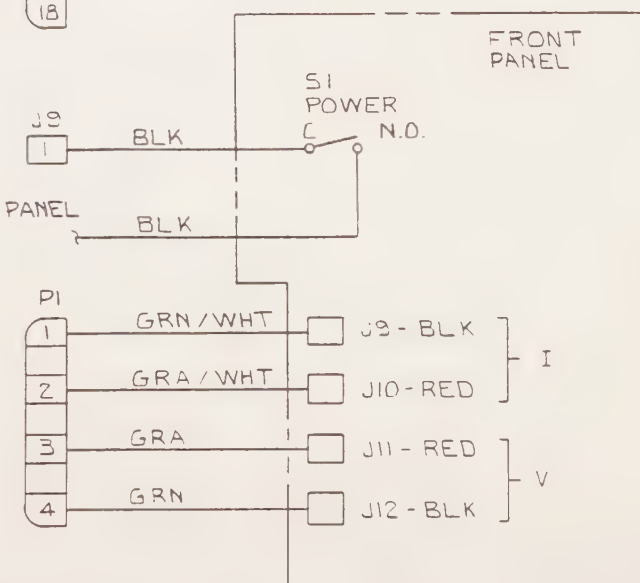
THE DESIGN AND OTHER INFORMATION CONTAINED IN THIS DRAWING ARE PROPERTY OF FLOW TECHNOLOGY, INC. EXCEPT FOR RIGHTS EXPRESSLY GRANTED BY CONTRACT THIS DRAWING MAY NOT IN WHOLE OR IN PART BE DUPLICATED OR USED FOR MANUFACTURE WITHOUT WRITTEN PERMISSION OF FLOW TECHNOLOGY, INC.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
B		REV AND REDRAW PER ECR 7091	7-21-81	John D. JEM

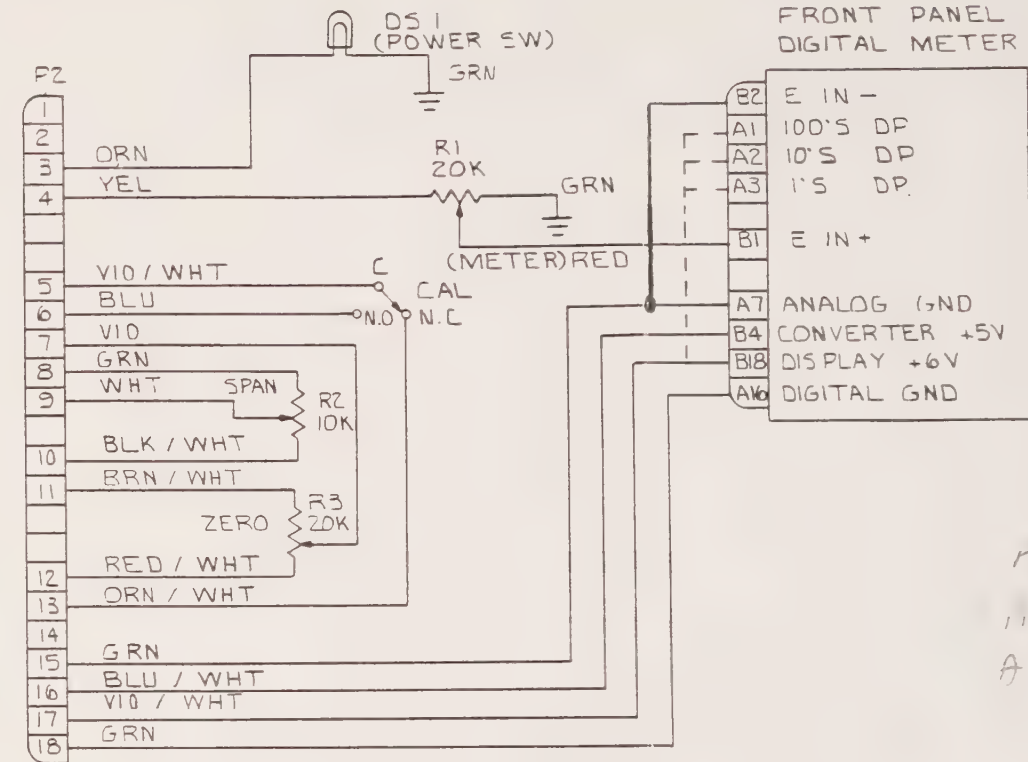


SEE DWG
63082539

TO FI REAR PANEL
SEE DWG
63082539



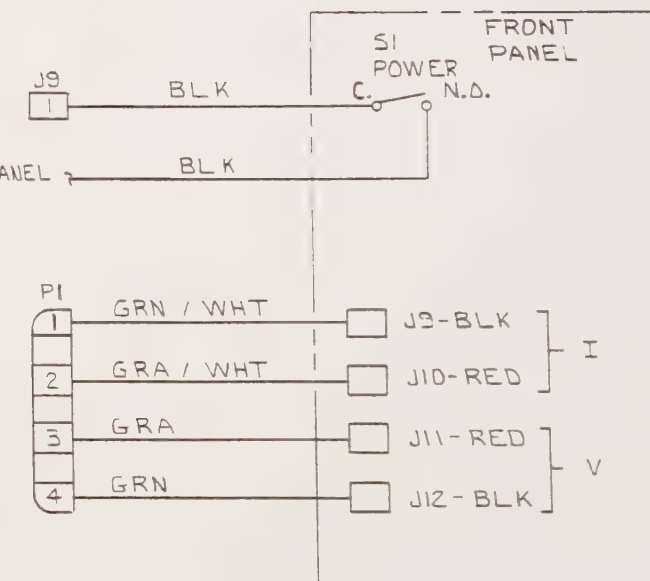
SRI-1



AS = 0.00
A2 = 0.00
A1 = 0.00

SEE DWG
63082539

TO FI REAR PANEL
SEE DWG
63082539



SRI-2

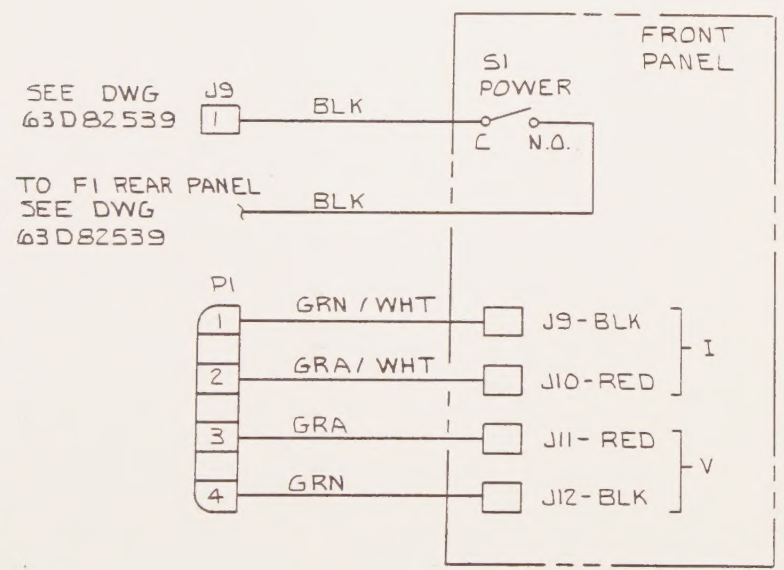
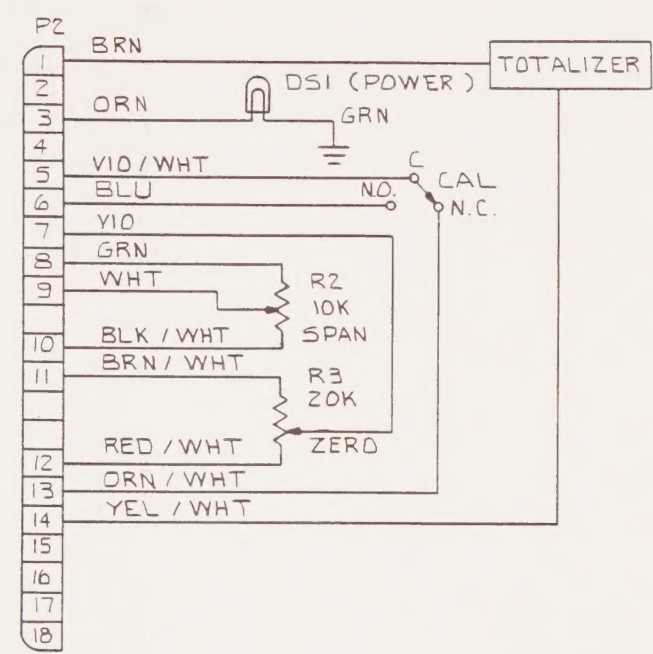
QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION			
PARTS LIST						
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES $\pm 1/64$ $\pm .010$ $\pm 30'$ $\pm .005$ $\pm .005$ MATERIAL FINISH DO NOT SCALE DRAWING			CONTRACT NO.		 FLOW TECHNOLOGY, INC. PHOENIX ARIZONA	
			APPROVALS			DATE
			DRAWN D BLAIN			78-11-21
			CHECKED R. HULLIHAN			11-21-78
			J BONA			11-21-78
WIRING DIAGRAM, FRONT PANEL - ECONO-LINE, SERIES III						
SIZE			CODE IDENT NO.	DRAWING NO.		
D			18316	90070558		
SCALE NONE			SHEET 1 OF 3			

WIRING DIAGRAM,
FRONT PANEL -
ECONO-LINE, SERIES III

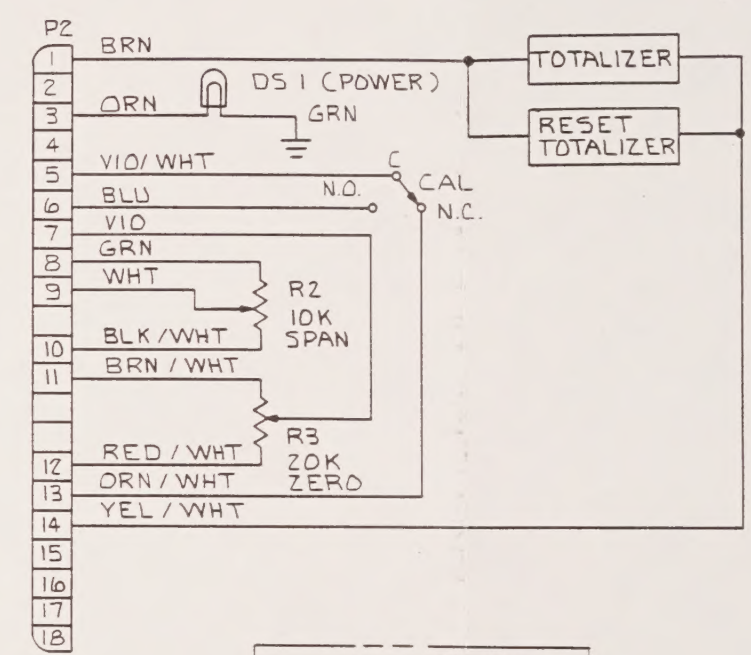
FLOW TECHNOLOGY, INC.
PHOENIX ARIZONA

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REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
		SEE SHEET 1 FOR REV	

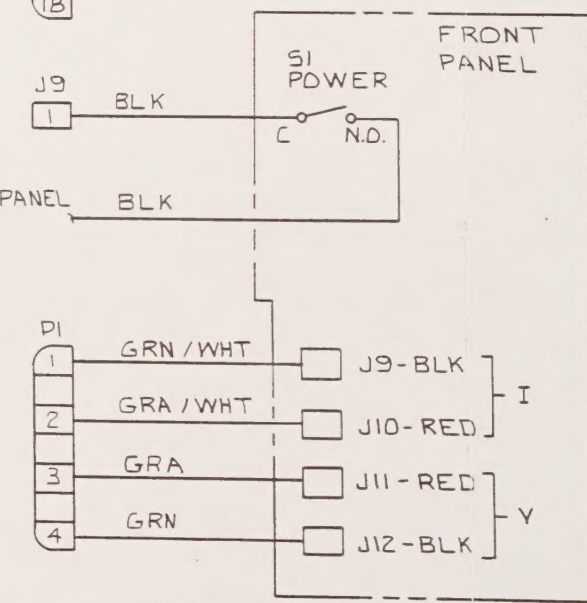


SPC-1



SEE DWG 63D82539

TO FI REAR PANEL SEE DWG 63D82539



SPC-2

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:			
FRACTIONS	DECIMALS	ANGLES	
± 1/64	XX ± .010	± 30°	
	XXX ± .005		
MATERIAL		CONTRACT NO.	
FINISH		APPROVALS	DATE
NEXT ASSY USED ON		DRAWN D BLAIN	78-11-21
APPLICATION		CHECKED R HULLIHAN	78-11-22
		J BONA	78-11-28
		DO NOT SCALE DRAWING	
		SIZE	CODE IDENT NO. DRAWING NO.
		D	18316 90070558
		SCALE NONE	SHEET 3 OF 3

WIRING DIAGRAM
FRONT PANEL -
ECONO-LINE SERIES III

FLOW TECHNOLOGY, INC.
PHOENIX ARIZONA

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